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PUBLIC HEALTH MONOGRAPH NO. 48

Long-Time Trends In Illness And Medical Care

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PUBLIC HEALTH SERVICE

A Review and Study of Illness And Medical Care

With Special Reference to Long-Time Trends

Selwyn D. Collins, Ph.D.

Public Health Monograph No. 48

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Introduction

For many years the facts about births and deaths have been recorded in at least the large cities of most of the civilized countries of the world. It is said that Thomas Cromwell (1485–1540), Vicar General under Henry VIII of England, was the first to set up in any country a system of registration of three of the now common types of vital records—births, deaths, and marriages (*1*). The systems for recording these events in the various countries were usually set up for legal and related purposes such as proving nativity and family relationships needed by the courts of law and equity in the settlement of inheritances as designated in wills and according to the law of the land in cases where no will was left by the decedent. Eventually, these vital records became useful and helpful to health department administrators and legislative bodies as indicators of the health of the population, although such uses were not a primary motive for their collection and tabulation.

However, records of nonfatal illness did not have direct and usable functions in courts and other governmental organizations, except in the conduct of health departments, which were usually a later development than other departments of government. But data on the presence and spread of infectious diseases were of paramount importance in the early days of health departments. Thus, some hundred years ago the health agencies of a few States of the United States obtained laws and regulations requiring the reporting of certain communicable diseases by attending physicians, and sometimes also by the families of the patients, to assist in the suppression of epidemics of these diseases that caused many deaths and much loss of time from work or other usual activities.

Brief History of Illness Surveys

The household-survey method of gathering records of illness, particularly nonfatal illness, is by no means a new instrument for collecting data of various kinds. Surveys of the extent and kind of illness in a community have been made from time to time during the past century. Questions about certain illnesses and physical and mental impairments were included as early as 1850 in the Irish censuses and as early as 1880 in the Australian censuses. Similar questions were later added to various State censuses, including Massachusetts and New York in 1885, 1895, and 1905, and to the United States censuses of 1890, 1900, and 1910. Surveys of the condition of families of workers in a number of large cities were made by the United States Bureau of Labor in the 1890's and surveys of typhoid fever were made in parts of some States by the Public Health Service.

The first principles for estimating the prevalence of illness in any locality were based on some ratio of illnesses to deaths. Thus, William Farr of England (*2*) laid down the principle that the percentage of the population constantly sick (prevalence) equals twice the annual death rate per 100. On that basis, Lemuel Shattuck (*3*) estimated for the 1845 popu-

lation of Boston, a prevalence rate of illness of 4.08 percent (twice the annual death rate of 2.04 per 100 population). Prevalence of illness, then as now, was defined as the proportion of persons sick at a given time.

Following these early efforts, the Metropolitan Life Insurance Company in 1915–17 made household illness-prevalence surveys of some half-million persons, recording by diagnosis, age, and sex, sickness which existed on the day of the visit, and its duration up to the time of the interview (*4*).

The United States Children's Bureau during the period 1915–23 published the results of extensive field studies of infant mortality in various cities (*5*).

Some 40 years ago, in 1916–17, Edgar Sydenstricker, the first statistician employed by the Public Health Service, working with Joseph Goldberger and G. A. Wheeler on pellagra (*6*) in cotton-mill villages of South Carolina, initiated surveys of illness from all causes in a number of the villages (*7–9*) in which pellagra studies were being made by means of household visits. While surveys of the prevalence of illness had been made by various agencies, as summarized above, one of these three studies (*9*), in which visits were made biweekly, was the first to record over a period of time the incidence of new cases of illness in contrast to recording only the prevalence of illness existing on the day of the interview.

In 1921, Sydenstricker (*10*) began a household survey of the extent and causes of illness and the extent of medical care among the general population of all ages and both sexes in a sizable sample of families living in Hagerstown, Md. As already noted, most prior studies of this kind had recorded only the prevalence of illness on the day of the interview, but in this study, covering 28 months (December 1921–March 1924, inclusive), the families were visited at intervals of 6 weeks to 2 months and records were made of all illness that had occurred since the preceding visit, thus again affording data on the incidence of illness over a period of time. An annotated bibliography of the Hagerstown Health Studies (Public Health Service Publication No. 148, Public Health Bibliography Series No. 6) is available.

In the latter half of the 19th century and in the early years of the 20th century, the development of anesthesiology, surgery, bacteriology, X-rays, and other related sciences and procedures eventually led to immunization against various infectious diseases and to more effective therapeutic procedures for such diseases. The results of these various activities led to great improvements in many fields of medicine and to a large reduction in the incidence of the acute infectious diseases and in their case fatalities, both of which contributed to lower death rates.

Thus, now, at the middle of the 20th century, the important causes of death are no longer the acute infectious diseases nor the diseases of young adults, for which surgery was most effective, but the noninfectious, chronic diseases of the older ages, of which the cardiovascular-renal group caused about 54 percent of all deaths in the United States during the years 1954 and 1955 (*11*). In the same period, deaths from heart disease alone accounted for 38 percent of deaths from all causes and arteriosclerotic heart disease, for 26 percent of deaths from all causes and 68 percent of all deaths from heart diseases. Certain acute infectious diseases are still serious as causes of crippling and death, but the group as a whole assumes much less importance than formerly. Thus, attention is now centered on the noninfectious diseases of the older ages, which are seldom reportable by attending physicians or others because these diseases are not a menace to well persons who come in contact with them. However, a number of States and countries have made cancer and some other noninfectious chronic diseases reportable to health departments, even though reporting of the acute infectious diseases by attending physicians has seldom been complete; it is generally thought that the extension of the system to all diseases would be an unjustifiable burden upon practicing physicians, and that the reports would be incomplete in many important respects.

In the absence of any continuing data on illness, except for the reportable communicable diseases, and the predominant place of the noninfectious cardiovascular-renal diseases as major causes of death, illness surveys have multiplied in number and complexity in the last

four decades because of the many aspects of these chronic diseases that require study.

Important illness surveys since about 1915 include: Morbidity studies in Hagerstown, Md. (*10*), in Syracuse, N. Y. (*12*), and in Cattaraugus County, N. Y. (*13*); the National Health Survey of 1935–36 (*14–16*); the Metropolitan Life Insurance Company study of the prevalence of illness in 10 surveyed communities (*4*); analyses of data from studies by the Committee on the Costs of Medical Care (*17*, *18*); study of illness in the Eastern Health District of Baltimore, 1938–43 (*19–25*); and the 1936 communicable disease study (*26*, *27*). (Much of the data on age and sex variation in illness are based on 5 studies with 80,768 full-time years of observation of white persons (*12*, *13*, *17*, *18*, *19–25*). The studies by the Committee on the Costs of Medical Care are counted as two studies—the families observed the whole year and the families observed only part of the year. The 6 studies with 97,285 full-time years of observation of white persons include the Hagerstown studies (*10*) with the 5 studies listed above.)

Since about 1945, extensive and detailed studies on illness and related subjects have been made in various areas. These studies include: Health Insurance Plan of Greater New York (*28*); Hunterdon County, N. J., study (*29*, *30*); Commission on Chronic Illness, Baltimore study of chronic diseases (*31*, *32*); Community Studies, Inc., chronic disease and rehabilitation study in Kansas City (*33*); studies by the Health Information Foundation, New York, N. Y. (*34*); the California State Department of Public Health illness studies, with supplementary studies in California cities, in cooperation with the Bureau of the Census (*35–39*); and illness studies by the University of California (*40*).

The health of the Nation became such an important issue that a committee to study and report upon the subject was appointed by the President in December 1951. While there was not time for an extensive field study within the life of the committee, a five-volume report, based on data already available, was prepared, including the proceedings of hearings made by the committee in numerous localities to get the views of various individuals and organizations on health and medical care needs in the United States (*41*).

All of this interest and activity in illness surveys was climaxed in July 1956 by the passage by the Congress of a bill providing for a continuous survey of illness in representative sample areas of the United States, plans and preparation for which are being made by the Public Health Service and the Bureau of the Census (*42–44*).

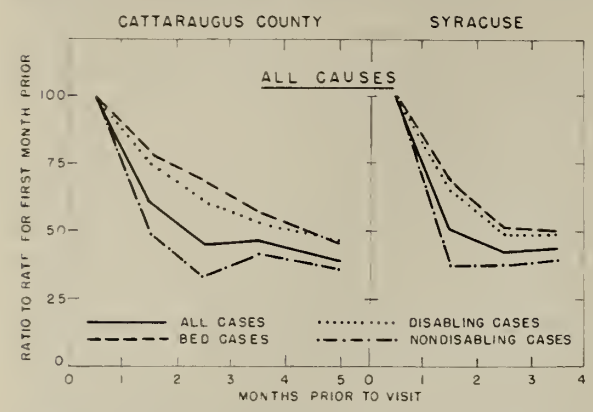
No doubt other important studies of illness by the survey method have been made in recent years, but the above references are sufficient to indicate the large increase in such studies during the past 4 decades.

Completeness of Reports in Illness Surveys

Periodic surveys of the incidence of illness as here used refer to surveys in which the same families are visited at stated intervals and asked about illness with onset during a specified time period, usually since the last preceding visit. The frequency of visits is important because the less frequent the visits the more cases of a minor and even of a moderately severe character will be forgotten by the household informant during the relatively brief interview, but the more frequent the visits the more costly the survey.

Sydenstricker has discussed this question clearly (*45*). He says, "Experience has shown that the completeness of a record of illness depends upon at least three important conditions. One is its severity and nature; the second is the length of the period for which the informant is asked to report; the third is the subjectivity of the record itself. * * * few will

Figure 1. Ratio (percent) of recorded case frequency from all causes in different months prior to the interview, to the case frequency for the first month prior to the interview—house-to-house surveys of illness in New York State.



NOTE: Rates corrected for seasonal variation. On this and similar charts, zero on the horizontal scale represents the day of the interview and the rate for the first month prior is plotted midway between 0 and 1 month; similarly, the second month prior is plotted midway between 1 and 2 months, etc.

recall a brief illness due to a common cold unless it occurred within a very short period immediately preceding the date of inquiry. Illnesses of a minor kind are observed and remembered when incident upon the informant himself with a greater degree of completeness than when incident upon others, even in the same family."

Figure 1 illustrates this principle; in the studies made in upper New York State, it was not possible, for several reasons, to make the visits at regular intervals. However, in the tabulations, the populations in terms of full-time years of observation were computed separately for the first month preceding an interview, and for the second, third, and back to the fourth and fifth months, in the few instances when the interval since the last preceding visit was that long. The illnesses were classified in the same way, according to the number of months prior to the interview in which they had their onsets and also in three severity categories: nondisabling, disabling for 1 day or longer, and confined to bed for 1 day or longer. Disabling cases were defined as those causing inability to be about work or other usual activities, whether the patient worked away from home, did housework in her own home, or attended school. Bed cases were classified as a subgroup of disabling cases.

Reported illness from all causes in all of the severity categories decreased rather consistently as the month for which the report was being made was further removed from the day of the interview, and the less severe the illness the more frequently the memory of the household informant failed to recall it. The largest decrease comes between the first and second months preceding the interview, apparently due to a large number of cases of minor respiratory, minor digestive, and other minor illnesses being forgotten by the informant in an average period of a month. A hand tabulation, by weeks, of a sample of schedules from the Eastern Health District Study in Baltimore indicated that remembered minor illnesses with onset in the first month prior to a visit fell off rapidly as the interval between the visit and the week being reported upon increased. However, it must be remembered that the reported illnesses included many minor cases of these and other trivial illnesses (*19*, *21*). Another source of incompleteness of reports is the necessity of obtaining information from one person, usually the housewife, for the whole family. People usually remember their own illnesses better than they remember the illnesses of others but to interview each person in a study involves many call-backs, and this was not feasible (*46*).

Although the various rates on which the ratios (percentages) in figure 1 and similar charts are based are not adjusted for age, they are all based on the population being visited periodically, and the age distribution would not be expected to vary greatly from month to month. However, the frequency of visits, particularly in the rural area, varied in winter when bad weather would hamper the work, as compared with the frequency of visits in the summer when the roads would be clear of snow and ice. Therefore, the data in figure 1 and in all similar charts were adjusted for seasonal variation by computing separate rates for each quarter of the year and computing a simple average of the four rates before computing the percentages shown in these charts.

Referring to figure 1 for cases of illness from all causes for both sexes, it is seen that the dis-

abling and bed cases remembered and reported to the interviewer after a 3- to 4-month period, amounted to little more than 50 percent of those remembered and reported as having their onset in the first month prior to the interview. It must be remembered, however, that the criterion of disability and confinement to bed for 1 day or longer would include many rather mild cases. However, of the nondisabling cases (causing no loss of time from work, school, or other usual activities), those remembered and reported as occurring 3 to 4 months prior to

Figure 2. Ratio (percent) of recorded case frequency from certain causes of illness in different months prior to the interview, to the case frequency for the first month prior to the interview—house-to-house surveys of illness in New York State.

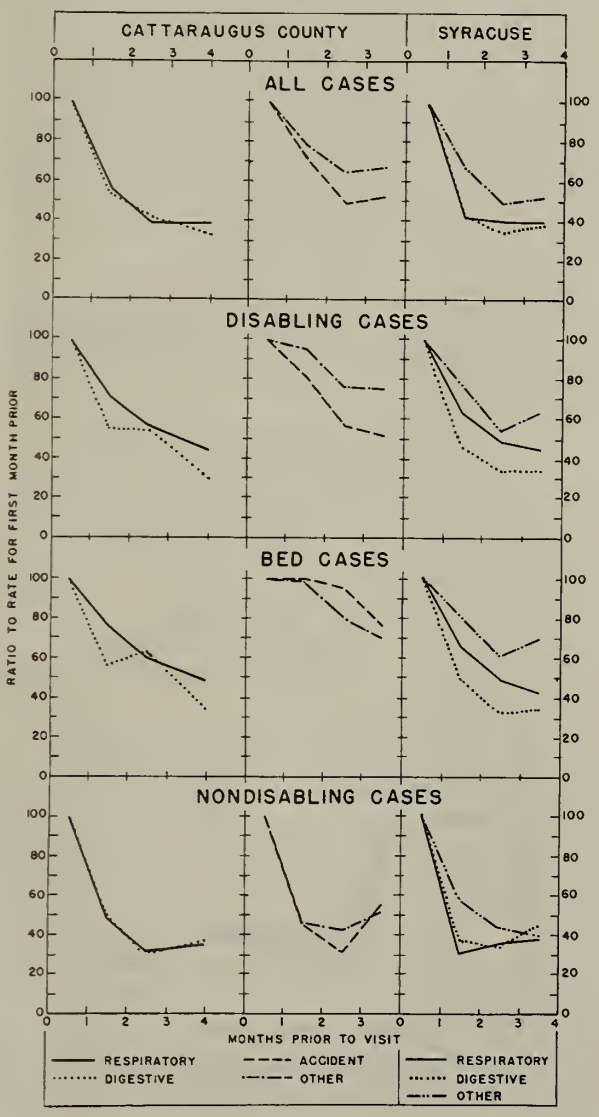
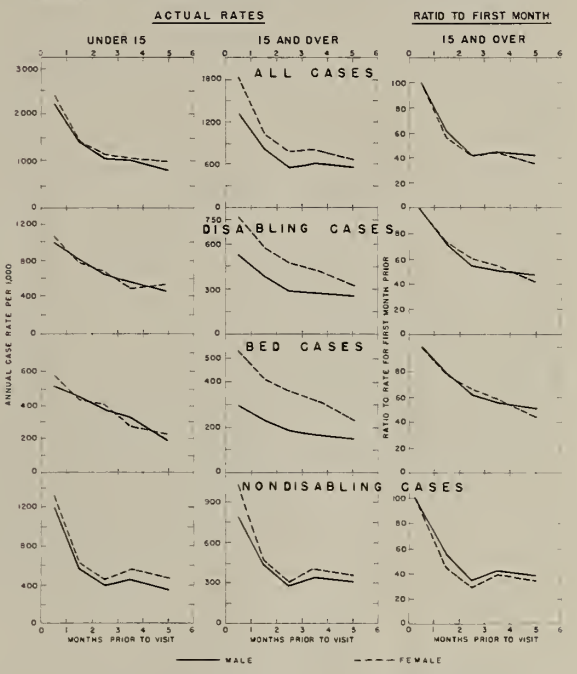


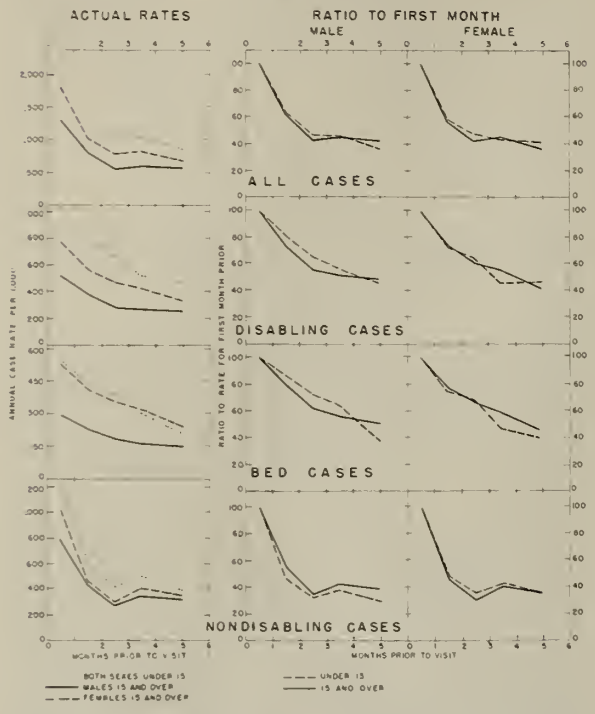
Figure 3. Recorded case frequency from all causes among male and female children and adults in different months prior to the family interview, and for adult males and females the ratio (percent) of the case frequency in the second and later months to that in the first month prior to the interview—house-to-house surveys of illness in Cattaraugus County, N. Y.



the interview amounted to roughly one-third of those remembered during the first month prior to the interview. Even with allowance for the unconscious bias of reporting some cases in a month nearer to the interview than the one in which they actually occurred, these data suggest that, unless the cases recorded are limited strictly to moderately severe cases (such as those disabling for a week or longer), one cannot expect to obtain in a sickness survey anything like the complete record of minor illnesses for much more than the first or possibly the second month prior to the interview.

Figure 2 shows similar ratios for 4 causes of illness in Cattaraugus County and 3 causes in Syracuse, N. Y. In Cattaraugus County, disabling and bed cases of digestive diseases fall off somewhat more rapidly than the same categories of respiratory diseases as the period to be remembered becomes longer, but nondisabling cases of the two diagnoses fall off at practically the same rate. Accidents are less well remembered than diseases other than respiratory and digestive, except for bed cases.

Figure 4. Recorded case frequency from all causes among male and female adults and among all children in different months prior to the family interview: and for children and adults of each sex, the ratio (percent) of the case frequency in the second and later months to that in the first month prior to the interview—house-to-house surveys of illness in Cattaraugus County, N. Y.



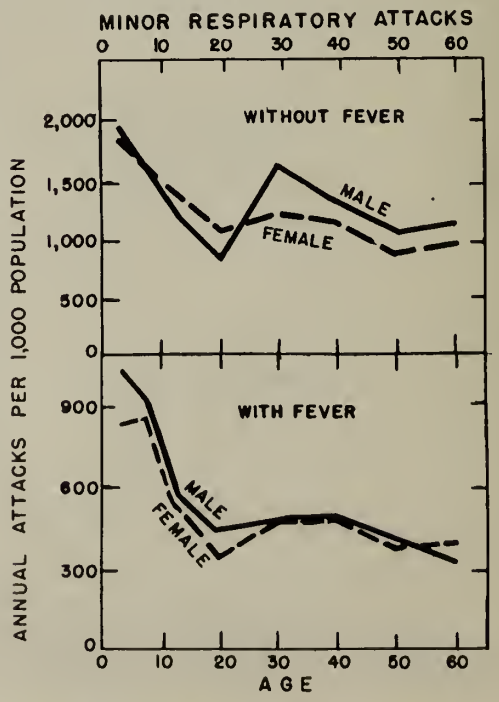
In Syracuse, disabling and bed cases of digestive diseases were also less well remembered than respiratory and "other" diseases, but in nondisabling and in total cases, respiratory and digestive diseases fall off at approximately the same ratios.

The data thus far considered on the question of memory of cases that had their onset several months prior to the interview had to do with rates for all ages of both sexes. However, the great majority of the household informants were adult women, usually the housewife. Figure 3 shows similar data by sex for persons under 15 years of age and for persons 15 years and older, and for the latter group the ratio (percent) that the rates for each month prior to the interview are to the rate for the first month prior to the interview.

The first column of figure 3 shows that among children under 15 years of age the actual illness rates per 1,000 for boys and for girls not only fall off at approximately the same ratios but that there is little difference between the actual illness rates for boys and for girls under 15 years of age, except that girls have slightly but consistently more nondisabling cases than boys.

For persons aged 15 years and over, the actual rates are shown by sex in the second column of figure 3, and the ratios to the rate for the first month prior to the interview are shown in percentages in the third column. In all except nondisabling cases, the actual rates are considerably and consistently higher for women than for men; even nondisabling cases are slightly higher for women. The ratios of frequency rate to the rate for the first month prior to the interview indicate that the fall-off in remembered cases, as the interval between the dates of interview and months to which the reports apply increases, is approximately the same for women and for men in all except nondisabling cases. Thus, it appears that there was about as much forgetting of cases for the women, who were generally reporting upon

Figure 5. Case frequency of minor respiratory attacks of two severity categories among males and females as reported semimonthly by the male household head—families of medical officers of the Army, Navy, Public Health Service, and the faculties of certain medical colleges.



themselves, as for the men of the household, who were generally reported upon by the women.

The first column of figure 4 shows actual illness rates on the same scale for both sexes under 15 years, and by sex for persons 15 years and over. As already noted, actual rates for children under 15 years of age are higher than for persons of either sex who were 15 years or older, except for bed cases for females 15 years or older. The second and third columns show by sex the fall-off in remembered cases among persons under 15 years of age is compared with those 15 years and older. Among females, the fall-off in remembered cases is about the same for both age groups. Among males, remembered disabling and bed cases fall off somewhat more rapidly at the ages of 15 years and over than among those under 15 years, but the reverse is true for nondisabling cases.

Downes and Mertz (*47*) have brought together data from a number of other studies of different kinds to indicate the importance of the frequency of visits in obtaining complete reports of minor illnesses in household included in illness surveys.

Figure 5 is of interest because it is based on a study of minor respiratory diseases in which the men were the reporters for the family, in response to a form sent to them by mail at semimonthly intervals. The data here shown include all minor respiratory attacks, those with fever and those without fever. It may be noted that the age incidence of attacks with fever are similar for males and females, but the reported incidence of attacks without fever is consistently higher for males above 25 years of age. While men may have more minor respiratory attacks without fever, the consistently higher rates for men of the ages who are reporting for the family suggest that they remembered and reported more minor attacks because they knew and remembered their own history of such attacks better than those of the wives and other adult women in the household.

Age and Sex Variation in Broad Types of Cases for All Causes

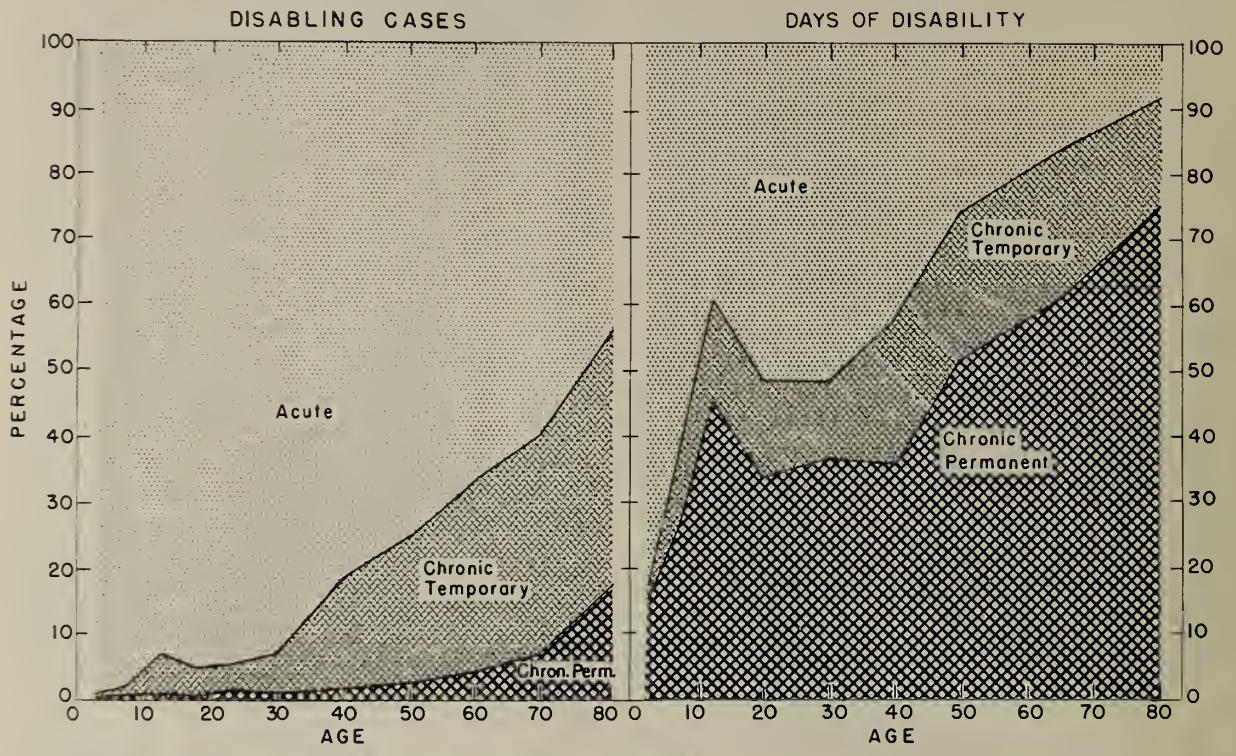
Without going into specific diagnoses, considerable interesting and useful information can be secured about types of caseloads by the use of such categories as acute and chronic diseases.

Both Sexes

First, it may be worth while to consider the percentage of cases or attacks for the Baltimore study (*19–25*) and of days of disability that were classifiable as acute, chronic temporary, and chronic permanent. Chronic temporary cases refer to those cases of chronic illness which were terminated by recovery or death at some time during the study, as contrasted with chronic permanent cases of illness in patients who were sick throughout the period that they were under observation. Figure 6 shows by age the percentages of all cases or attacks of illness, and the percentage of all days of disability that were due to acute, chronic temporary, and chronic permanent diseases or residuals of accidents. The peak in days of disability that occurs at 10–14 years of age is due almost entirely to chronic permanent conditions, but of course it shows up in the total of both temporary and permanent chronics in a cumulative chart of this kind, probably representing such serious diseases as poliomyelitis and rheumatic fever as well as serious residuals of accidents.

About 93 percent of the cases of illness at 30 years of age were acute, but by 80 years of age, about 57 percent of cases were chronic, and of these only about 18 percent were chronic permanent cases. In contrast, at 30 years of age nearly half of the days of disability were due to chronic conditions; at 80 years of age 91 percent of the days of disability were due to

Figure 6. Age variation in the proportion of cases and of days of disabling illness from all causes classified as acute disability, chronic temporary disability, and chronic permanent disability—white families canvassed at monthly intervals in a sample of the Eastern Health District of Baltimore, 1938–43.



NOTE: Chronic permanent disability refers to those cases disabled throughout the period of the patient's observation; other chronic cases are classified as temporary disability.

chronic diseases, and about 76 percent of the days of disability were due to chronic permanent cases.

Figure 7 shows various types of rates for acute and chronic cases by age as found in the Baltimore Eastern Health District Study: (*a*) annual frequency or incidence of cases or attacks with onset during the study period; (*b*) prevalence of cases existing at a given time regardless of the date of onset; (*c*) annual days of disability per person under observation; (*d*) days of disability per disabling case or attack; and (*e*) annual death rates in the total United States, 1950.

Acute illness is the predominating type among young people, and chronic disease among older persons; the highest incidence of acute cases occurs among children under 5 years of age, with a rapid decline in the rate to about 20 years of age, and a very gradual decline thereafter (fig. 7, middle section).

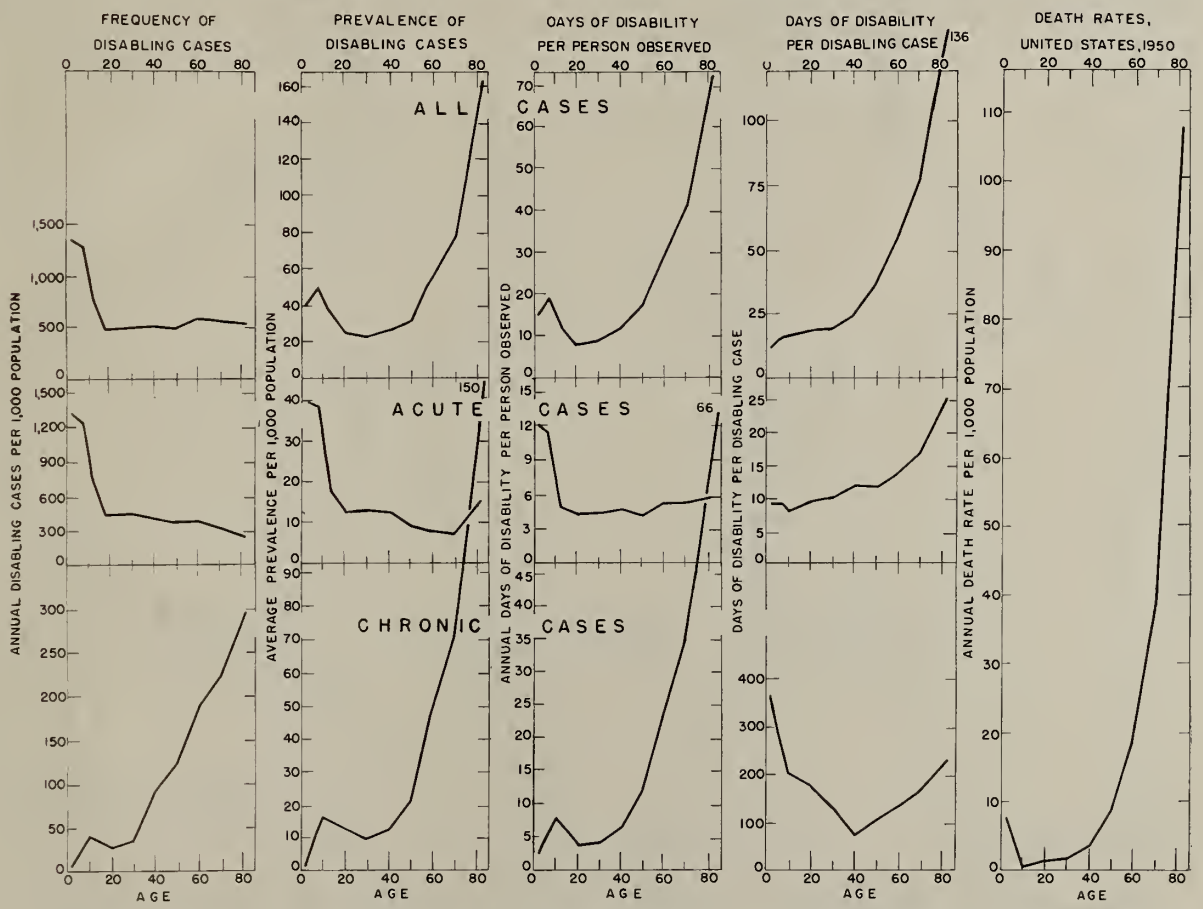
Chronic disease, on the other hand, tends toward a small peak in the ages around 5 to 14 years with a much more rapid and continuous rise in the rate to a maximum in the oldest ages (fig. 7, bottom section). The prevalence of illness from chronic disease at a given time has the same type of age curve as the days of disability from chronic disease per person observed. Inasmuch as prevalence on a given day (the average for the days on which the 60 monthly visits were made) really amounts to a sample of 1 day in 30 (3.33 percent), the similarity in relative age curves would be expected.

The top section of figure 7 shows curves of the types discussed above but includes all illness, both acute and chronic. In frequency rates for all types of cases, the age curve is similar to that of acute cases but the age curves of prevalence and of days of disability per person observed are similar to those for chronic cases. In frequency or incidence the short acute cases predominate, but in terms of days of disability the cases of long duration pre-

dominate, and thus the age curves resemble those of chronic diseases. In prevalence, the longer the duration of a case the greater the probability that it will exist on a selected day (day of a visit), and thus the age curve takes on the character of the days of chronic disability per person observed rather than that of acute cases and days of disability per person observed. As noted above, prevalence is really a sample of the days of disability of the cases. However, in days per case, even the acute cases rise with age, although not as rapidly as the total chronic and acute cases combined.

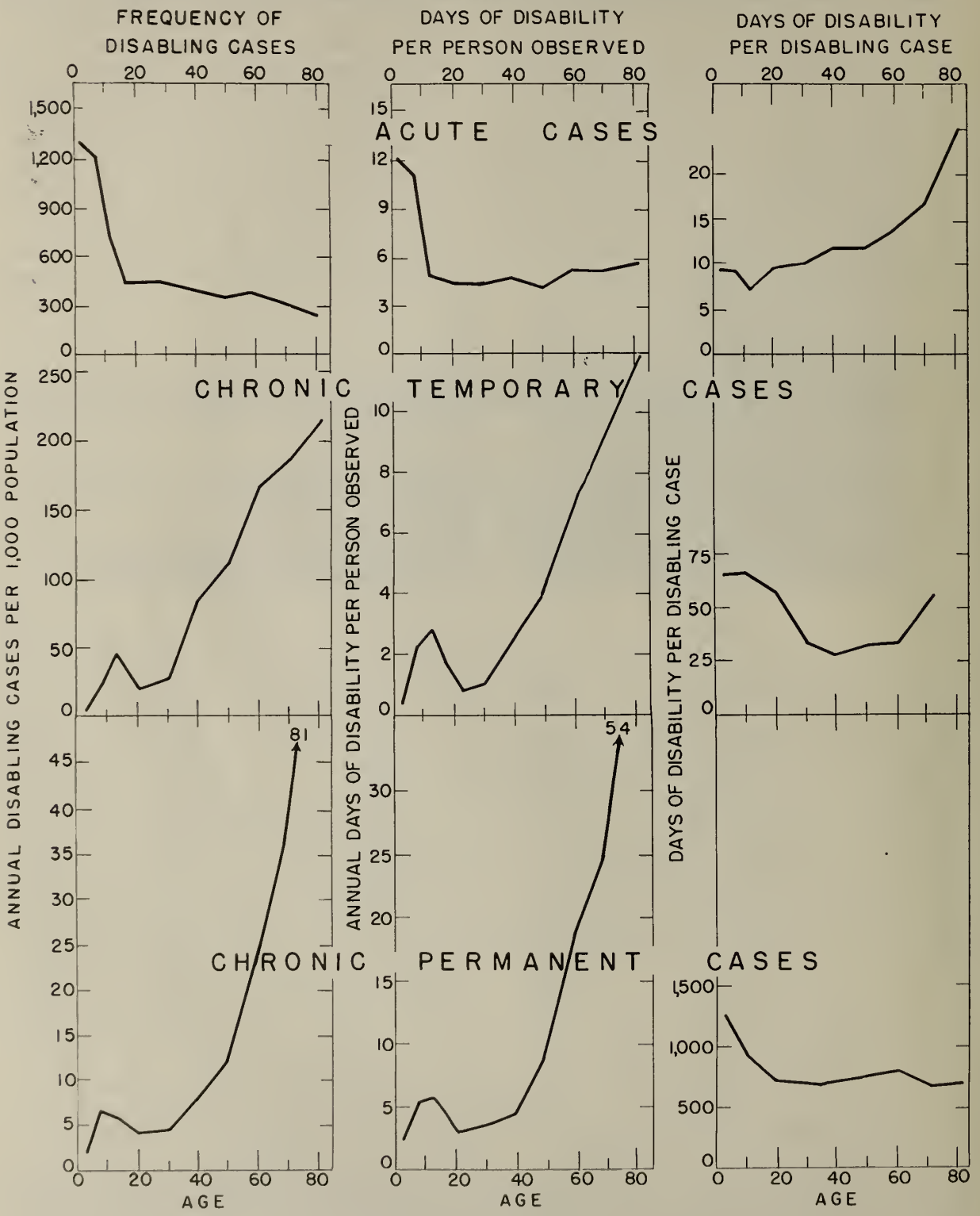
The box on the extreme right in figure 7 shows that in mortality the variation with age is far greater than in any of the several types of illness rates. Thus, an undue proportion of older persons in a population group has the greatest effect on the crude death rate. The next greatest effect of a preponderance of older persons is on the crude rate of prevalence of chronic disease and of the days of disability per person observed, particularly for the chronic degenerative diseases. On the other hand, the presence of a large proportion of children and young persons in the population makes for high crude rates of acute illness, particularly of the minor respiratory diseases,

Figure 7. Age variation in rates of acute and chronic disabling illness from all causes as measured by case frequency, prevalence, and by days per person observed and per case—white families canvassed at monthly intervals in a sample of the Eastern Health District of Baltimore, 1938–43; and deaths in the white population of the United States, 1950.



NOTE: Throughout this study, the vertical rate scales on this and similar charts change for the different diseases or types of cases and days. In all instances, the rate for both sexes of all ages represents on the vertical rate scale a distance equal to 30 years on the horizontal age scale. Thus the curves are on a relative basis similar to a curve representing the ratio of the rate in each age to the rate for all ages combined, but the vertical rate scales have been put on in terms of actual rates and actual disabling days.

Figure 8. Age variation in annual rates of acute disability, chronic temporary disability, and chronic permanent disability as measured in cases and days—Eastern Health District of Baltimore, 1938–43.



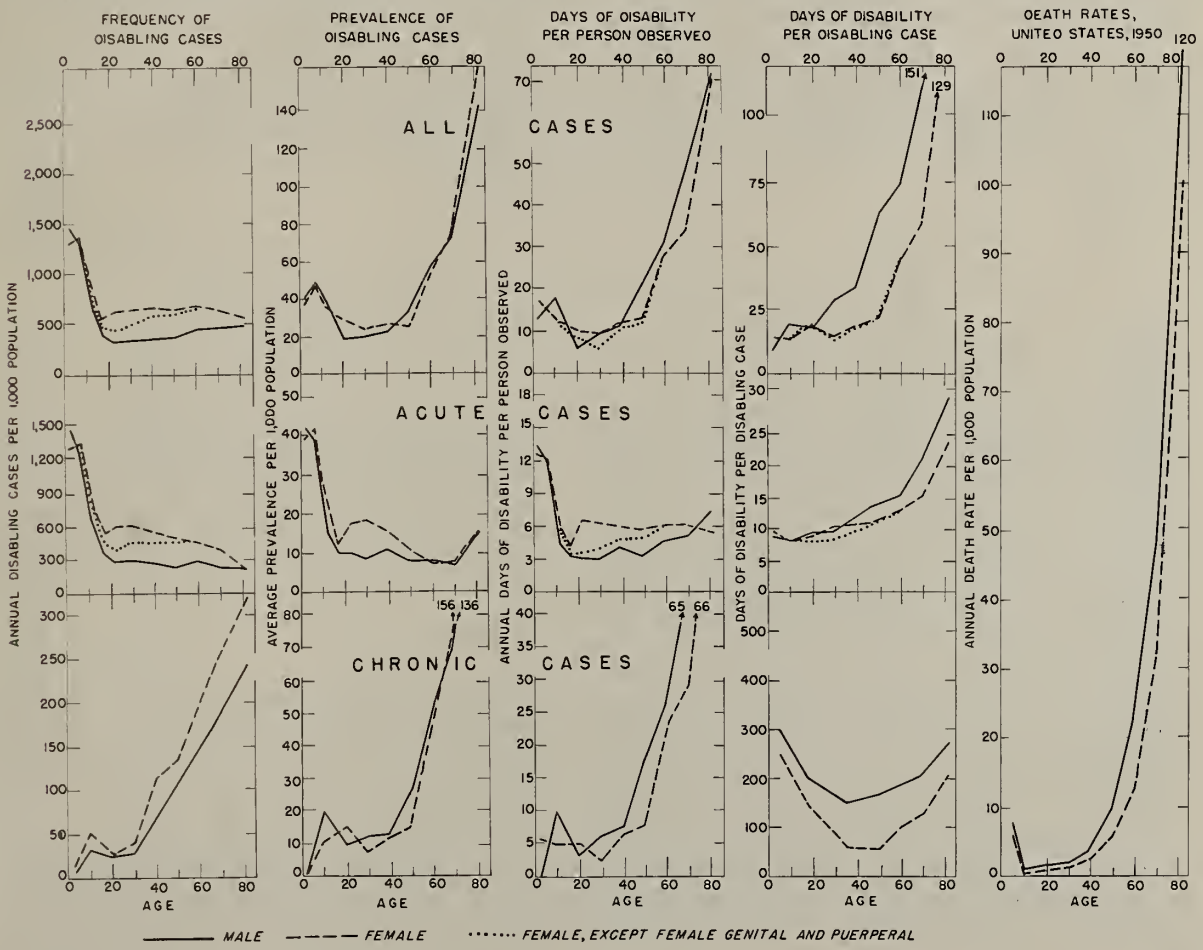
the minor digestive disturbances, and the acute infectious diseases that are so frequent among children.

Figure 8 shows age curves for acute cases, chronic temporary cases, and chronic permanent cases. The chronic temporary cases have the highest peaks in terms of actual frequency rates per 1,000 population, and this peak occurs in the oldest age group. However, the chronic permanent cases have relatively higher peaks in the oldest ages. In days of disability per person observed, the chronic permanent cases are higher, and in days of disability per disabling case the chronic permanent cases average 724 days per case compared with 43 days for chronic temporary cases. As already seen, the acute cases decline with age up to at least 20 years, both in frequency and in days of disability per person observed, but the days of disability per acute disabling cases increase with age, whereas both types of chronic cases have the highest days of disability per disabling case in the youngest ages.

Males and Females

Figure 9 shows data similar to those in figure 7 but for males and females separately. In terms of the frequency of disabling illness for persons under 20 years of age, differences between the sexes are reasonably small for total, acute, and chronic cases, but above 20 years there are moderate to marked and consistent differences, even when female genital and puerperal conditions are excluded. Male genital diseases are not of high frequency except for

Figure 9. Annual frequency, days of disability, and average prevalence of disabling illness from all causes, acute diseases, and chronic diseases among white males and females of specific ages—Eastern Health District of Baltimore sample, 1938–43; and annual death rates among white males and females of specific ages in the United States, 1950.


FREQUENCY OF DISABLING CASES
PREVALENCE OF DISABLING CASES
DAYS OF DISABILITY PER PERSON OBSERVED
DAYS OF DISABILITY PER DISABLING CASE
DEATH RATES, UNITED STATES, 1950
ALL CASES
ACUTE CASES
CHRONIC CASES
ANNUAL DISABLING CASES PER 1,000 POPULATION
AVERAGE PREVALENCE PER 1,000 POPULATION
ANNUAL DAYS OF DISABILITY PER PERSON OBSERVED
DAYS OF DISABILITY PER DISABLING CASE
ANNUAL DEATH RATE PER 1,000 POPULATION
AGE
MALE
FEMALE
FEMALE, EXCEPT FEMALE GENITAL AND PUERPERAL

circumcisions among the very young and prostate diseases in the older ages.

In the prevalence of all disabling cases and of disabling chronic cases, the sex differences are small and irregular, but females of the childbearing ages have higher acute case rates than do males. Approximately the same is true of the annual days of disability from acute cases per person observed, but for total cases, and especially for chronic cases for females above 40 years of age, the rates are rather consistently lower than those for males of the same ages. Similarly, in days of disability per disabling chronic case, females show consistently shorter average durations in all age groups and for total and acute cases in the ages above 20 and 40 years, respectively, particularly for all types of cases combined. Part of this showing of fewer days of disability per female observed and fewer days per case among females may reflect the presence of considerable numbers of housewives who are not working away from home but are doing their own necessary housework when they are really unable to be about their usual duties.

In contrast to the major part of the sickness picture as shown in the first 2 columns of figure 9 and in the first 3 boxes for acute cases, the section on the extreme right indicates that at every age the death rate for females is lower than for males, in spite of a higher frequency of illness of several categories among females, even when female genital and puerperal conditions are excluded. Moreover, when these diseases and conditions of the female genital organs are excluded from the causes of death, the death rate is changed very little. However, in terms of days of disability (third and fourth columns of the chart), adult females have lower rates than males in all except days of disability from acute cases per person observed.

One possible explanation of this partial contradiction between morbidity and mortality rates of males and females may be that females

Table 1. Percentage of persons of specific age and sex who were sick the specified number of times during 1 year of observation—Baltimore Eastern Health District 5-year illness study, 1938–43

Sex and age in years	Times sick during 1 year [1]										Total person-years observed [1]
	0	1 or more	1	2	3	4	5	6	7	8	9 or more	
All ages:												
Both sexes	45. 29	54. 71	24. 28	13. 33	8. 01	1. 04	2. 34	1. 39	0. 58	0. 27	0. 47	15, 813
Male	51. 87	48. 13	23. 68	11. 35	6. 56	3. 02	1. 76	. 89	. 41	. 16	. 30	7, 712
Female	39. 02	60. 98	24. 86	15. 22	9. 39	5. 01	2. 89	1. 86	. 74	. 38	. 63	8, 101
Under 10:												
Both sexes	23. 53	76. 47	22. 23	19. 33	13. 51	8. 40	5. 43	4. 01	1. 81	. 65	1. 10	1, 547
Male	22. 92	77. 08	24. 91	16. 51	14. 85	8. 31	5. 46	3. 21	1. 90	. 71	1. 19	842
Female	24. 26	75. 74	19. 01	22. 70	11. 91	8. 51	5. 39	4. 96	1. 70	. 57	. 99	705
10–19:												
Both sexes	48. 22	51. 78	24. 82	11. 84	7. 80	3. 28	1. 86	1. 31	. 45	. 14	. 28	2, 897
Male	50. 37	49. 63	25. 09	11. 11	7. 09	2. 93	1. 57	1. 23	. 27	. 14	. 20	1, 467
Female	46. 01	53. 99	24. 55	12. 58	8. 53	3. 64	2. 17	1. 40	. 63	. 14	. 35	1, 430
20–44:												
Both sexes	49. 93	50. 07	24. 01	12. 54	6. 70	3. 10	1. 85	. 78	. 42	. 21	. 46	6, 152
Male	59. 62	40. 38	22. 44	10. 18	4. 53	1. 77	1. 06	. 10	. 10	. 03	. 17	2, 937
Female	41. 09	58. 91	25. 41	14. 68	8. 68	4. 32	2. 58	1. 40	. 72	. 37	. 72	3, 215
45–64:												
Both sexes	47. 48	52. 52	25. 21	12. 65	7. 40	3. 28	1. 86	1. 13	. 31	. 29	. 39	3, 810
Male	57. 91	42. 09	23. 42	9. 81	4. 75	1. 89	1. 13	. 65	. 22	. 11	. 11	1, 853
Female	37. 61	62. 39	26. 88	15. 33	9. 92	4. 60	2. 55	1. 58	. 41	. 16	. 66	1, 957
65 and over:												
Both sexes	36. 89	63. 11	24. 16	15. 06	9. 81	6. 97	3. 34	2. 06	. 92	. 36	. 43	1, 407
Male	39. 80	60. 20	25. 28	15. 01	9. 14	5. 38	2. 45	1. 47	. 82	. 16	. 49	613
Female	34. 63	65. 37	23. 30	15. 11	10. 33	8. 19	4. 03	2. 52	1. 01	. 50	. 38	794

[1] A person may have been observed and counted in more than 1 study year if he had 10 or more months of observation in each of 2 or more study years. Nearly all persons were observed all 12 months of any given study year in which they were counted. Persons observed for less than 10 months in any study year are excluded from that year.

suffer more frequent short-term minor ailments than do males, but serious long-term cases occur more frequently among males. One type of case that meets this theory consists of severe accidents, which usually occur more frequently among males than females.

Another interesting and useful index of illness is the distribution of males and females of given ages according to the number of times they are sick during a specified period, such as 1 year. Such data are available from the Baltimore Eastern Health District Study and are shown in table 1. The study extended over a 5-year period, the months covered in each study year being June to May, inclusive. Persons who were under observation for 10 or more months of any study year were included in the table for as many study years as they were observed; the great majority of those included were in the study for the whole 12 months of the years involved. Thus, the percentages in table 1 represent approximate times sick from any cause and of any severity during a year. Data are shown by sex for five rather broad age groups.

For all ages of both sexes, 45 percent had no illness during the 12 months, and 55 percent had 1 or more illnesses. However, 5 percent had 5 or more illnesses and 0.5 percent had 9 or more illnesses. Of the males of all ages, 48 percent had 1 or more illnesses and 3.5 percent had 5 or more illnesses. These figures may be compared with 61 and 6.5 percent, respectively, for females, including figures for female genital diseases, pregnancy complications, and deliveries.

Of the children under 10 years of age, 76 percent had 1 or more illnesses, with practically the same percentage for boys and girls; at 10–19 years, 50 and 54 percent of boys and girls, respectively, had 1 or more illnesses, with 52 percent for both sexes combined. However, at 20–44 years, the major childbearing ages, 59 percent of the women had 1 or more illnesses as compared with 40 percent of the men. The difference between the sexes is about as large at 45–64 years, but at 65 years and over the percentages of persons with 1 or more illnesses were 60 and 65 for males and females, respectively, but 5.4 percent of the males had 5 or more illnesses compared with 8.4 percent of the females. These latter percentages are considerably larger than for any other age group.

Hospital Surgical and Nonsurgical Cases

By way of comparison and contrast, it seems worth while to look first at the age curves for all cases and for all surgical cases, and the percentage of all cases that were treated surgically, and at a similar set of rates for hospital cases only.

All Hospitals

In a group of five illness surveys (*48*, *90*) of some years ago, which covered 80,768 full-time person-years of observation of white families, only 6 percent of all recorded cases were treated surgically, compared with 64 percent of all hospital admissions treated surgically (fig. 10). Rates of all hospitalization for females of the childbearing ages are much higher than those for males, but when female genital and puerperal causes are excluded, the hospitalization rates for females are not excessively higher than those for males. Hospital surgical cases for females, exclusive of female genital and puerperal causes, show a relatively greater excess over males than is true of all hospital cases. However, in total illnesses the peak rates for all cases among females of the childbearing ages are not greatly changed by the exclusion of female genital and puerperal conditions, but among hospital surgical cases the same types of exclusions reduce the rates for females relatively much more. In the proportion of all cases (nonhospital and hospital) that were treated surgically (upper half of fig. 10), females show a lower percentage so treated in

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Figure 10. Annual age- and sex-specific rates per 1,000 population for all cases and hospital cases; all operations and hospital operations; and the percentage of all cases and of hospital cases treated surgically—white families canvassed periodically in 5 illness surveys with 80,768 person-years of observation.

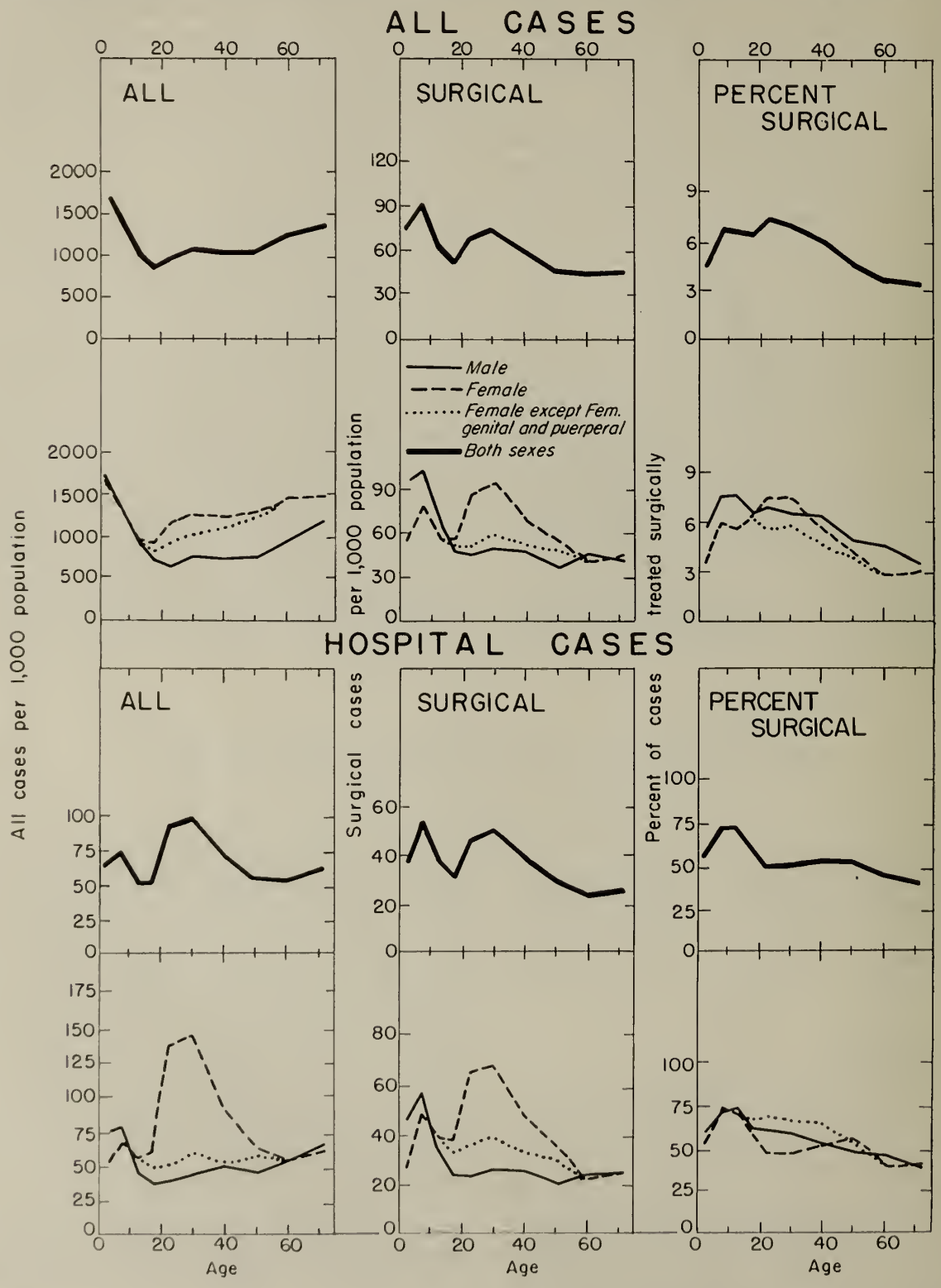
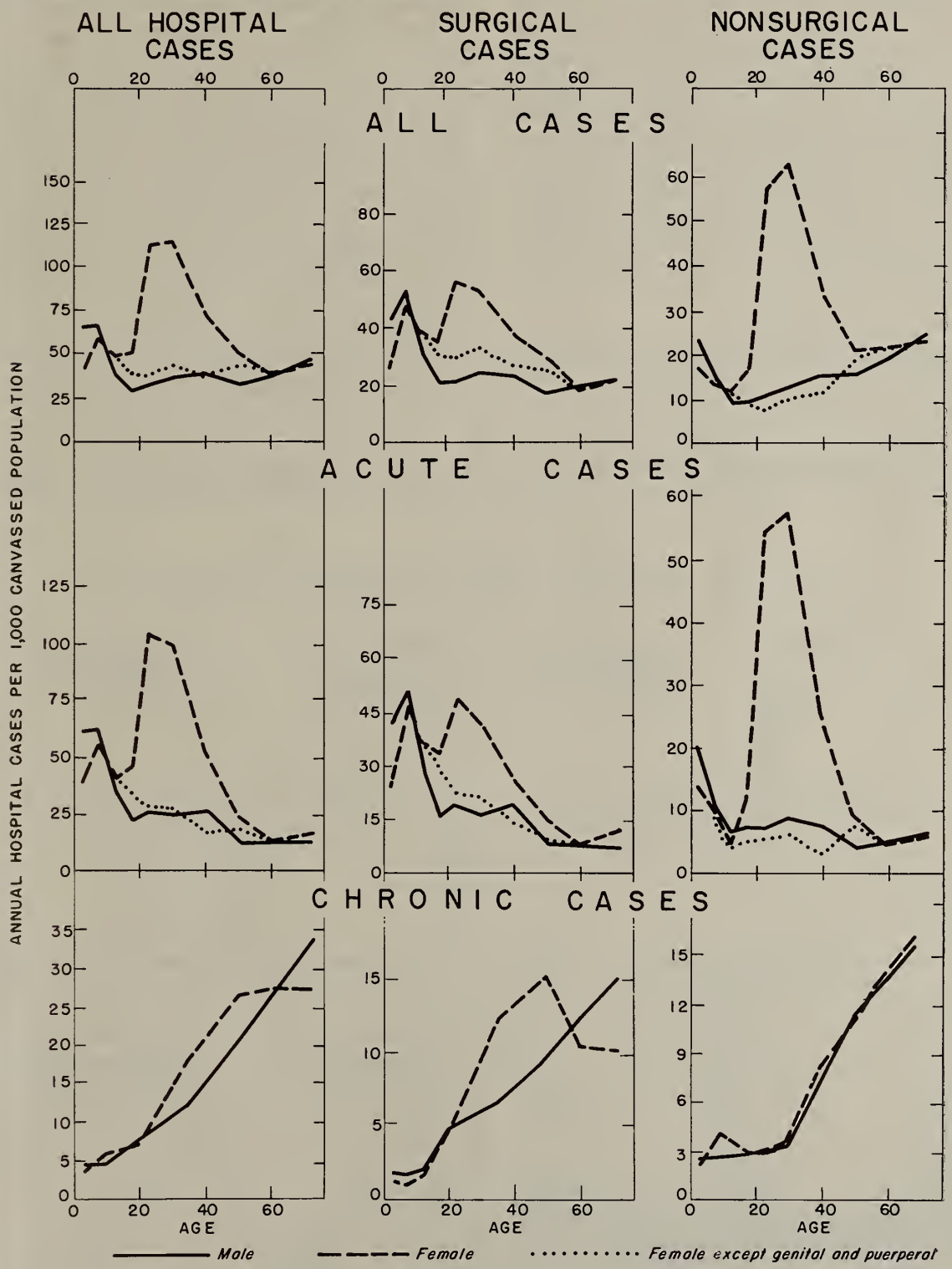


Figure 11. Annual age- and sex-specific hospital admissions per 1,000 population for all acute and chronic cases, with each category classified by surgical and nonsurgical treatment—5 surveys with 80,768 full-time person-years of observation.



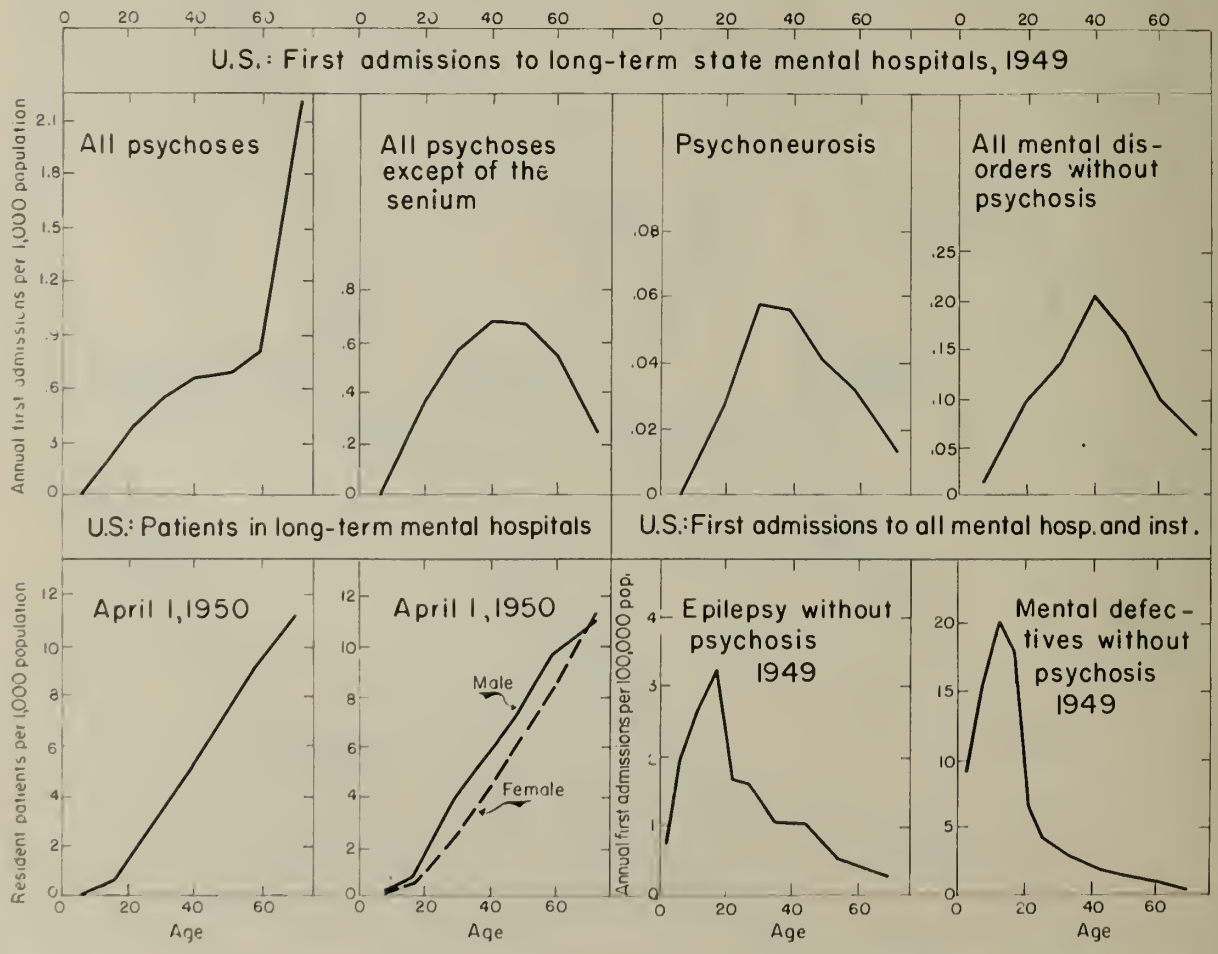
every age group from 20 to 60 years when female genital and puerperal cases are excluded.

Two broad types of hospitals are quite different in the kind of hospital and the kind of patients admitted: hospitals for short-term cases, both surgical and nonsurgical, which are rather frequently found in both large and small cities and occasionally in rural areas; and hospitals for long-term cases, particularly for mental and related causes, tuberculosis, paralysis, rheumatic fever, heart and circulatory diseases, and some other diseases that require institutional care.

Short-Term Hospitals

Considering first all admissions to short-term hospitals, both surgical and nonsurgical, for either acute or chronic diseases, figure 11 shows that nonsurgical cases have a very high peak in the acute nonsurgical category at the child-bearing ages, which to a large extent represents deliveries; 94 percent of all deliveries in the total population of the United States now occur in hospitals. A lower peak at about the same ages which occurs in the acute surgical category represents largely female genital diseases, many of which are treated surgically. The dotted lines for total and acute cases represent rates for females when the conditions affecting the female genital organs and their functions are eliminated from the picture. In the nonsurgical group, this correction leaves lower hospital rates for females than for males, but in the surgical categories the rates for females, exclusive of female genital and puerperal cases, are still slightly higher than those for males.

Figure 12. Annual age-specific rates per 1,000 population for first admissions for psychoses and for neurological diseases in specified years, and prevalence rates of patients in long-term mental hospitals on April 1, 1950.

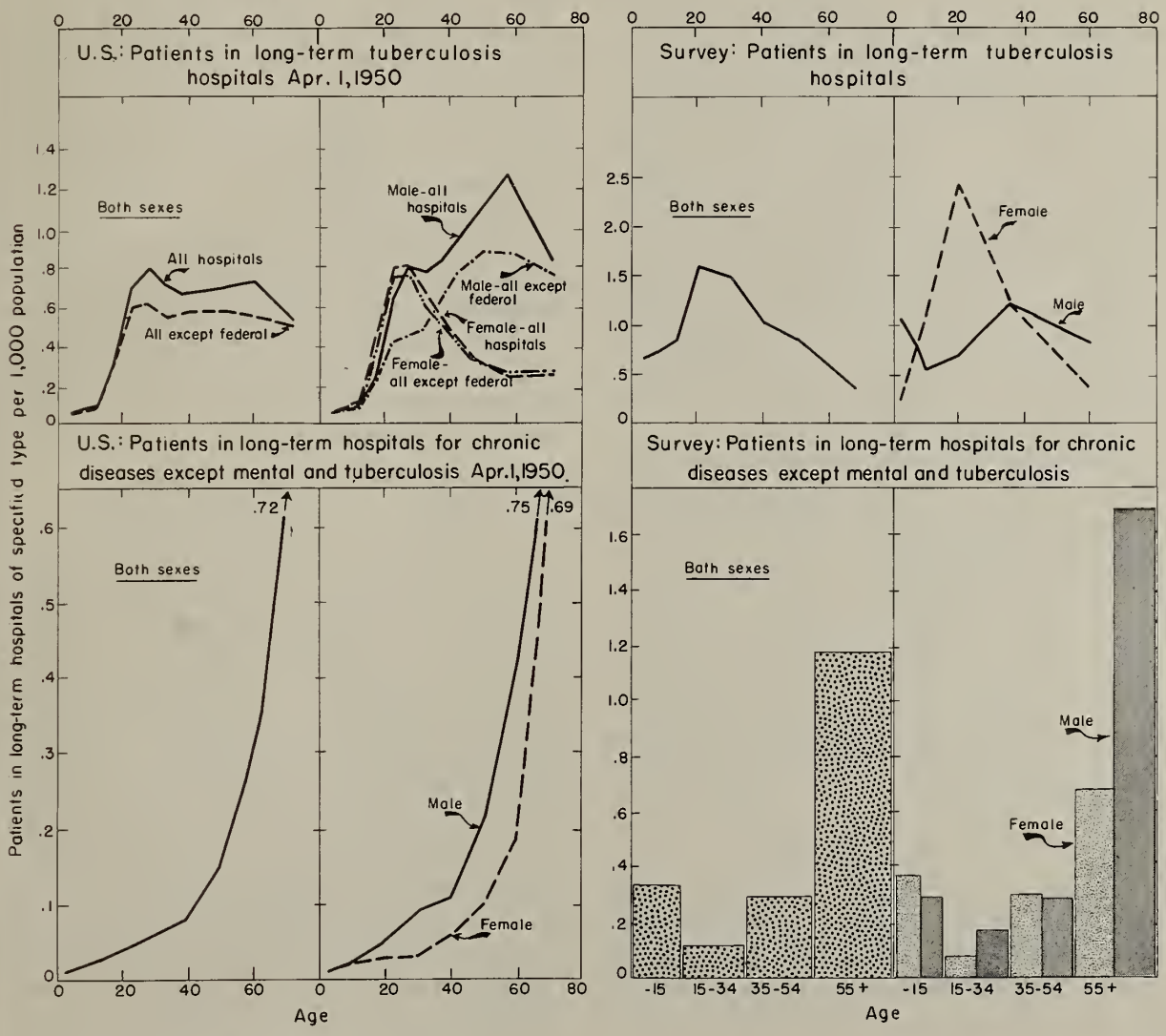


Chronic hospital surgical cases are higher for females for the ages 25 to 55 years, but in the chronic nonsurgical category the rates for the two sexes are almost identical.

Long-Term Hospitals

Mental diseases, tuberculosis, and some cases of other chronic diseases that require institutional care are so different in the types of care and treatment received that the great majority are in hospitals built and conducted in rather different ways from short-term hospitals. For some of these long-term hospitals, particularly for mental and allied diseases, the admissions per year are few compared with the total cases in the hospital at a given time (average daily census). Thus, such places are referred to as "resident hospitals" because they become, for all practical purposes, the place of residence of the patient. Because of this fact, patients of this kind are often lost sight of in recording the roster of persons belonging to the household, so they, particularly the older adult patients, are somewhat under-reported in family surveys; accurate data on their numbers must be obtained from hospital records and reports, such as are now collected and published

Figure 13. Age- and sex-specific rates of patients in long-term tuberculosis hospitals, and in long-term hospitals for chronic disease except mental and tuberculosis—United States, April 1, 1950, with comparative data for the 5 surveys (*51*).



by the National Institute of Mental Health (*49*), and formerly by the Bureau of the Census (*50*).

Mental Hospitals

The top half of figure 12 shows rates by age for first admissions to long-term mental hospitals for all psychoses; all psychoses except those of the senium (including senile psychosis and psychosis with cerebral arteriosclerosis); all psychoneuroses; and all mental disorders without psychosis.

Figure 12 shows that the only one of these broad groups of first admissions for mental disorders that has a peak above 40 years of age is "all psychoses," and that the elimination of psychoses of the senium leaves "all psychoses except of the senium" with a peak at 40 years, although the rate for the ages 45–54 is almost as high. However, the two righthand boxes in the lower half of figure 12 show that epileptics and mental defectives without psychosis show peaks at 15–19 and 10–14 years, respectively, for first admissions to special institutions for these conditions and to mental hospitals. In showing these latter conditions without psychosis, it is assumed that the additional diagnosis of psychosis puts them in the more serious category as psychotics. As might be expected, first admissions for these two conditions without psychosis have younger age peaks than the corresponding diagnoses with psychosis.

As already noted, the number of annual admissions to long-term mental hospitals is small compared with the number of patients in these hospitals at a given time; as shown in the two lower left boxes of figure 12, the age distributions of the patients are also quite different, representing an approximately straight line from 17 to 60 years, with a negligible number of patients under 15 years of age. Throughout these ages, from approximately 17 to 60 years, there are more males than females in mental hospitals.

Tuberculosis Hospitals

The top left half of figure 13 shows age-specific rates for patients in long-term tuberculosis hopsitals. In the left box, for both sexes combined, it would appear that the elimination of tuberculosis cases in Federal hospitals leaves the relative age curve about the same as for all tuberculosis hospitals in the United States. However, when the data are plotted by sex, the peak rates for females are at 25 to 29 years of age, with a definite drop to a rate for the ages 65 and over that is lower than for any age except those under 15 years. On the other hand, the rates for males under 30 years of age in all long-term tuberculosis hospitals are similar to the rate for females, but beyond that age the rate for males continues upward to a peak of 1.26 per 1,000 population at 55–59 years, with a drop to a rate of 1.14 at 60–64 and 0.82 for the ages 65 and over that is roughly three times the rate for females of those ages but is only slightly above the rate for females 25–29 years of age.

If Federal hospitals are eliminated from the computation, rates for males are below those for females of the ages 10–34 years, but above 35 years they rise to considerably higher levels than the rates for females of the same ages. Thus it appears that it is important to take account of sex and of Federal hospitals in considering hospitalization in long-term tuberculosis hospitals.

The right half of the upper part of figure 13 shows age curves based on the few cases of tuberculosis reported in five periodic household surveys of some years ago as being in long-term hospitals. Even these few cases suggest that the peak age of tuberculosis is lower among women than among men.

Other Chronic Disease Hospitals

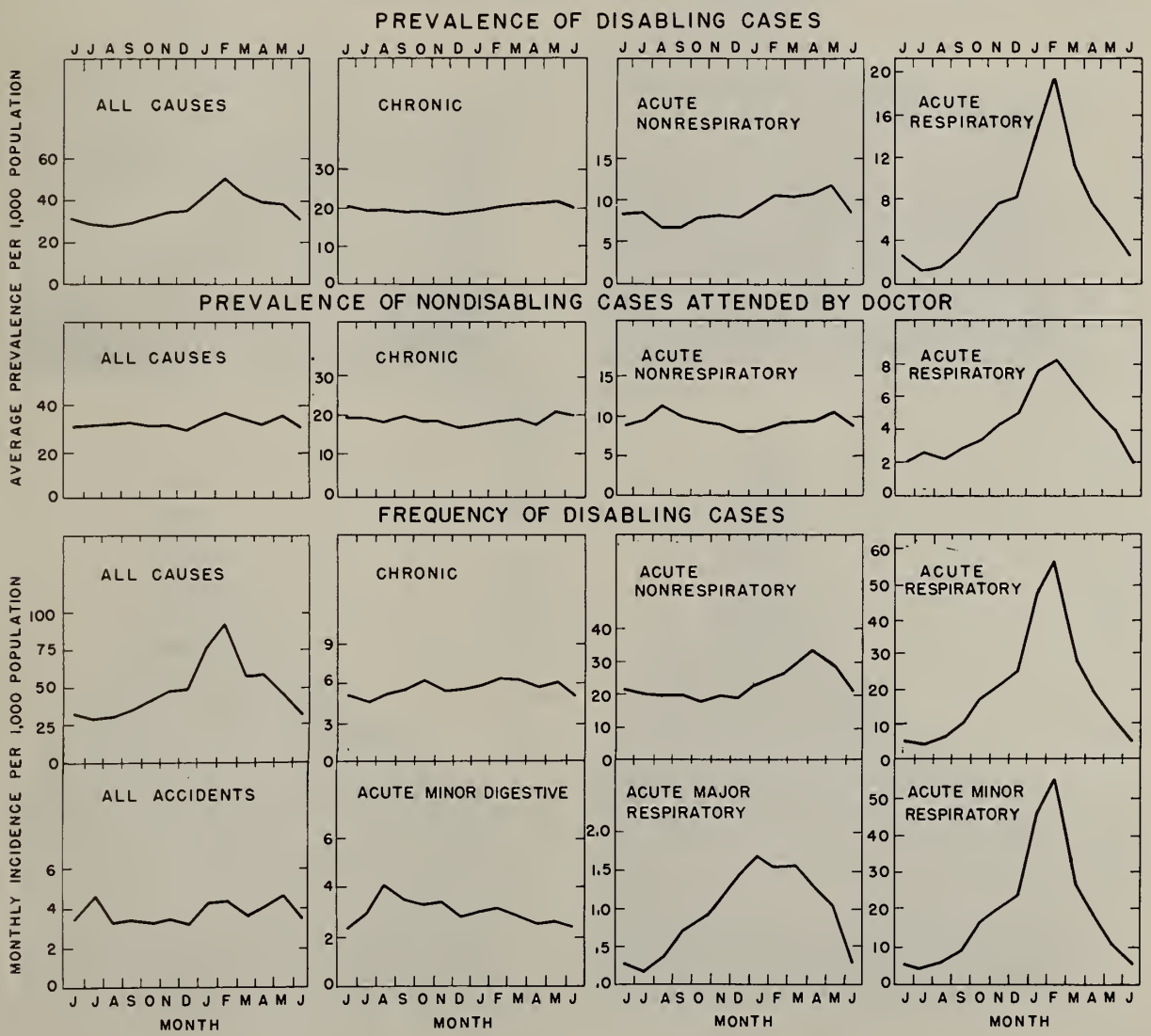
The lower half of figure 13 shows, by age and sex, patients in long-term hospitals for chronic diseases other than mental and neurological conditions and tuberculosis, as found by the census of 1950 and as reported in the five surveys conducted by, or in cooperation with, the Public Health Service (*48*, *51*). Considering the few cases of these diseases in the relatively small sample in the five surveys, there is rough agreement in the two pictures in that chronic diseases other than mental and tuberculous conditions are definitely of the old-age degenerative type although the five surveys seem to have included some excess of children under 15 years as compared with adults 15 to 34 years of age.

Seasonal Variation in Illness

In a 5-year illness survey of the Eastern Health District of Baltimore (*19–25*), monthly visits were made to a sample of families in that district. Data from that survey are available on the frequency of illness in that area, and also on the prevalence as recorded in broad diagnoses and by severity as it existed on the day of each of the 60 monthly visits during the 5-year period.

The prevalence and the frequency of acute disabling respiratory diseases are the only ones in these broad diagnosis groups that show enough seasonal variation to be reflected in all causes of illness (fig. 14). However, both the minor and the major respiratory groups show large seasonal variation in frequency, and the miscellaneous nonrespiratory groups show some seasonal variation. Chronic diseases as a group

Figure 14. Seasonal variation in the prevalence of disabling illness and of nondisabling illness attended by a doctor, and the frequency of disabling illness, by broad cause groups—Eastern Health District of Baltimore Morbidity Study, 1938–43.



show very little seasonal variation, particularly in prevalence.

Figure 15 shows seasonal variation in the prevalence and the incidence of disabling and of total illness, each subdivided by different hatching into the three broad diagnosis groups of chronic, acute respiratory, and acute nonrespiratory diseases. Seasonal variation is considerably greater in the incidence than in the prevalence of illness. The upper right segment of the chart of prevalence of all cases of illness, including nondisabling illness, shows the least

Figure 15. Average seasonal variation in the prevalence and in the incidence (30-day monthly basis) of illness as recorded in monthly visits to households—Eastern Health District of Baltimore Morbidity Study, 1938–43.

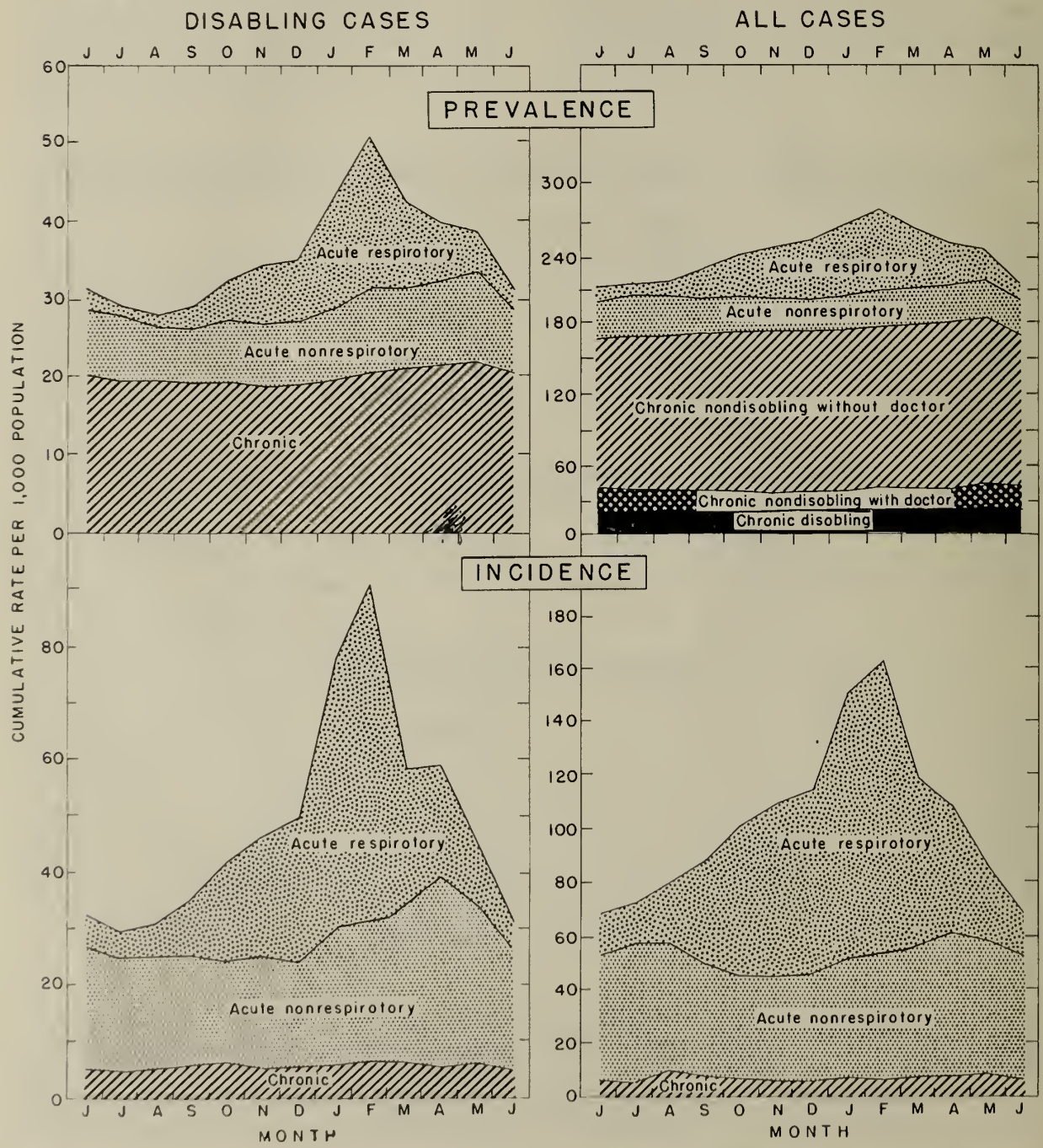
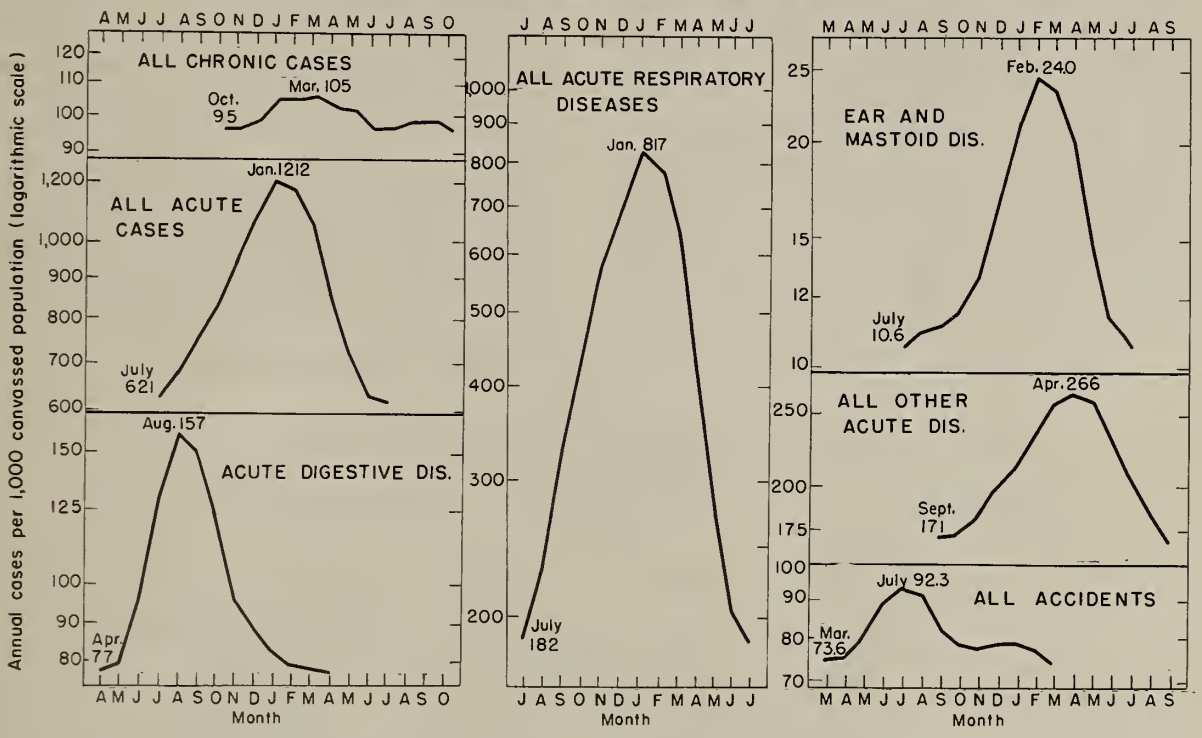


Figure 16. Relative seasonal variation in all chronic cases and in broad groups of acute cases—6 surveys with 97,285 full-time person-years of observation.


Annual cases per 1,000 canvassed population (logarithmic scale)
ALL CHRONIC CASES
Oct. 95
Mar. 105
ALL ACUTE CASES
July 621
Jan. 1212
ACUTE DIGESTIVE DIS.
Apr. 77
Aug. 157
ALL ACUTE RESPIRATORY DISEASES
July 182
Jan. 817
EAR AND MASTOID DIS.
July 10.6
Feb. 24.0
ALL OTHER ACUTE DIS.
Sept. 171
Apr. 266
ALL ACCIDENTS
Mar. 73.6
July 92.3
A M J J A S O N D J F M A M J J A S O
J A S O N D J F M A M J J
M A M J J A S O N D J F M A M J J A S
Month

seasonal variation and contains the largest group of chronic cases without the attendance of a doctor.

The upper left segment of the chart shows that there is greater relative seasonal variation in the disabling cases than in the total cases, and that it is the acute respiratory diseases that give rise to most of the seasonal variation from all causes; it is also apparent that chronic diseases as a whole have little seasonal variation although some included diagnoses may have considerable seasonal variation.

The lower half of the chart confirms the above statements and further indicates that it is the incidence or frequency of illness that shows the greatest seasonal variation.

In four less intensive illness surveys (*48*) than the one in Baltimore, but made by periodic household visits, records were also made of persons with a chronic disease, with entries for each attack or episode of illness, including many without disability, as well as those with 1 or more days of disability (in the sense of inability to be about usual activities), days confined to bed, and nights in a hospital. These various measures of the severity of the illness have been used and described in preceding sections in comparisons of age and sex variation in illness of acute and chronic types. These attacks or episodes of illness were recorded by date of onset and tabulated by month to show the seasonal variation in the frequency of episodes of specific chronic diseases, in the same way as attacks of acute diseases in the various months of the year.

In the upper left corner of figure 16 is shown a five-period moving average of the seasonal variation in the frequency of attacks of all chronic diseases and immediately below, a similar plot for all acute cases. Both are on the same logarithmic scale so that the height of the curve from low to high points gives an accurate picture of the relative seasonal variation in the incidence of cases. The rates for all chronic diseases considered together vary only from an annual rate of 95 per 1,000 in October to 105 in March, or 11 percent. In contrast, acute diseases occur nearly twice as frequently in winter as in summer; rates for all acute diseases combined vary from annual rates of 621 in July to 1,212 in January.

The rate for acute digestive diseases is lowest

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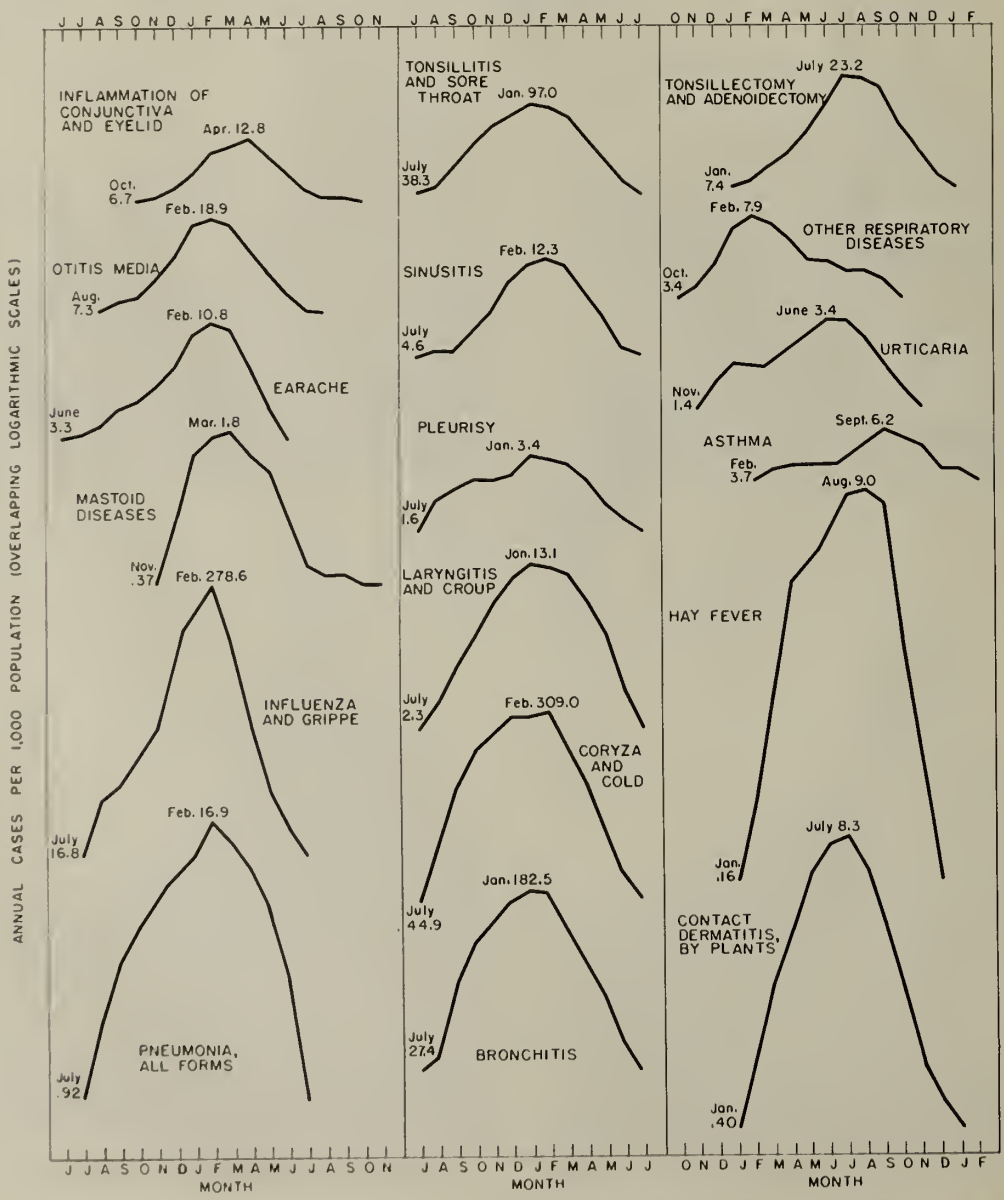
in April, but the peak in August is also about twice the April rate. Ear and mastoid diseases show similarly wide seasonal variability, with the low point in July and the high point in February, which is 2.3 times the low July rate. All other acute diseases combined show somewhat less variability with season of the year, and accidents vary still less, with a low point in March of 74 per 1,000 and a July peak of 92, or about 25 percent higher than the low month. The acute respiratory diseases are 4.5 times as frequent in the peak month of January as in the low month of July.

In figures 17–20, the rates for nearly all of the detailed diagnoses of illness found in these surveys are plotted by months as three-period moving averages of monthly rates (annual basis), with occasional combinations of 2 adjacent months to smooth out irregularities that appear to be due to chance. Since the vertical scale is logarithmic, no scale markers are indicated, but the low and high months and

Figure 17. Relative seasonal variation in detailed diagnoses of respiratory diseases and allergy.



their respective rates are entered on each seasonal curve. The rates are all plotted from low to high and back to low again. The resulting curves show reasonably accurate seasonal variation in the monthly incidence of illness from the various causes.

No detailed comment seems necessary on any large number of the diseases for which seasonal curves are shown on these four charts. Figure 17 shows the seasonal variation for respiratory and ear and mastoid diseases, and the allergies; figure 18, for the acute communicable and digestive diseases; figure 19, for skin diseases, accidents, male and female genital diseases and puerperal conditions, and a few miscellaneous diseases; and figure 20, for noninfectious diseases and a few miscellaneous and ill-defined diseases. (Figs. 19 and 20 on pp. 24 and 25).

Acute respiratory, acute communicable, and acute digestive diseases show the largest seasonal variation. The chronic diseases with considerable seasonal variation are diabetes, prostate diseases, rheumatic fever, heart and related diseases, hemorrhoids, peptic ulcer, gallbladder and liver diseases, and diseases of the organs of movement.

Figure 18. Relative seasonal variation in detailed diagnoses of infectious general and digestive diseases.

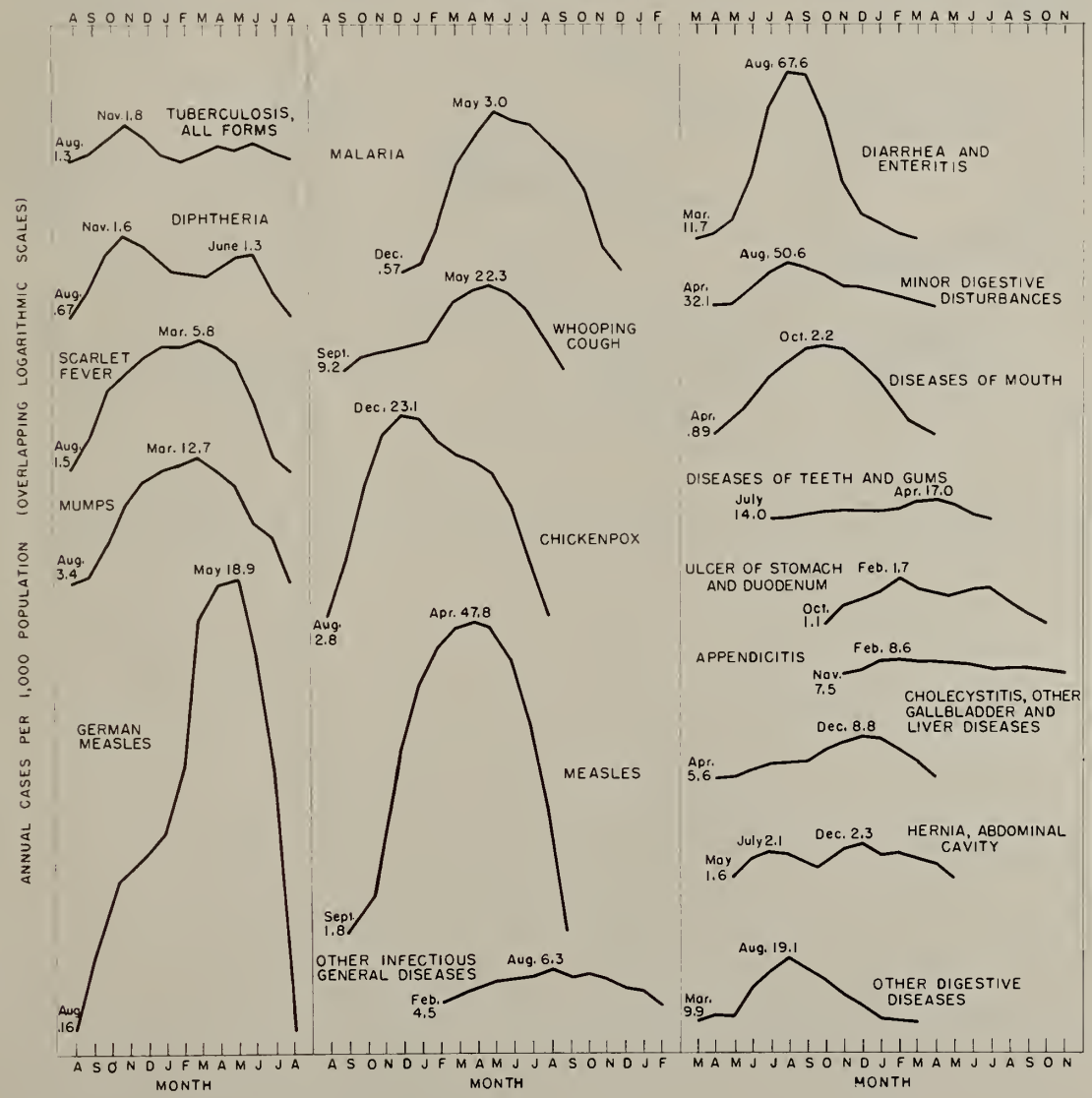


Figure 19. Relative seasonal variation in detailed diagnoses of diseases of the skin, congenital malformations, accidental injuries, male and female genital diseases, and deliveries.

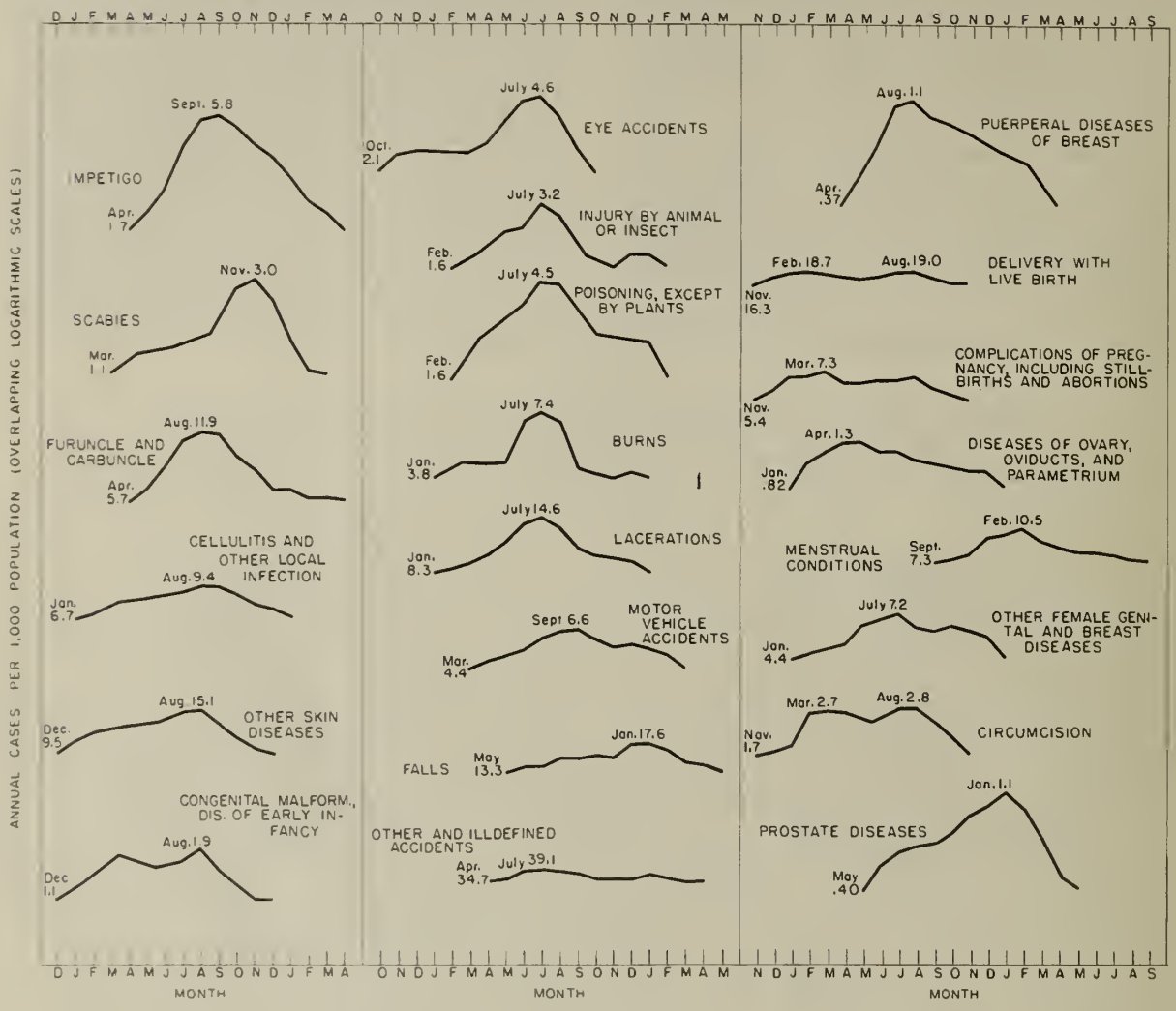
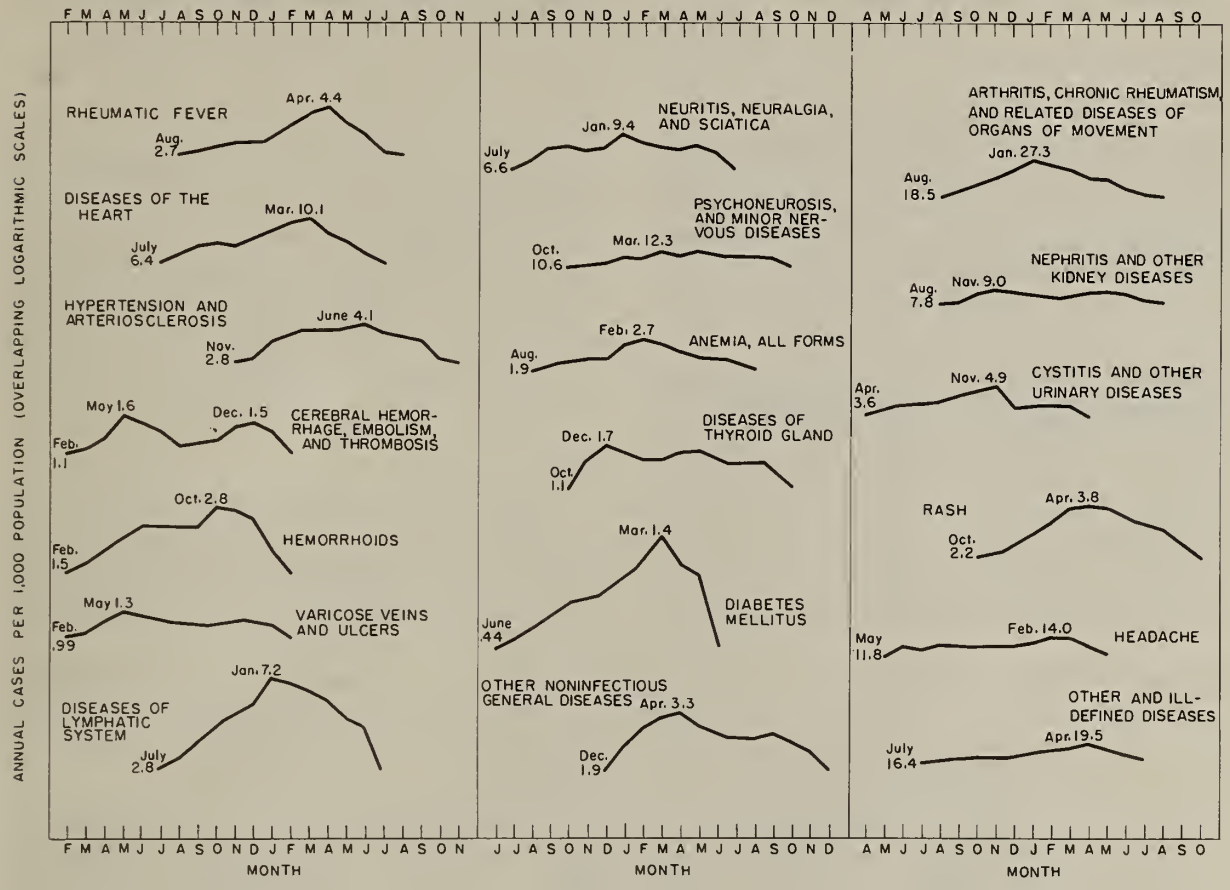


Figure 20. Relative seasonal variation in detailed diagnoses of diseases of the heart and circulatory system, neurological and glandular diseases, diseases of the kidney and urinary system, and ill-defined diseases.


ANNUAL CASES PER 1,000 POPULATION (OVERLAPPING LOGARITHMIC SCALES)
F M A M J J A S O N D J F M A M J J A S O N
J J A S O N D J F M A M J J A S O N D
A M J J A S O N D J F M A M J J A S O
RHEUMATIC FEVER
Apr. 4.4
Aug. 2.7
DISEASES OF THE HEART
Mar. 10.1
July 6.4
HYPERTENSION AND ARTERIOSCLEROSIS
June 4.1
Nov. 2.8
May 1.6
Dec. 1.5
Feb. 1.1
CEREBRAL HEMORRHAGE, EMBOLISM, AND THROMBOSIS
Oct. 2.8
Feb. 1.5
HEMORRHOIDS
May 1.3
Feb. .99
VARICOSE VEINS AND ULCERS
Jan. 7.2
DISEASES OF LYMPHATIC SYSTEM
July 2.8
NEURITIS, NEURALGIA, AND SCIATICA
Jan. 9.4
July 6.6
PSYCHONEUROSIS, AND MINOR NERVOUS DISEASES
Mar. 12.3
Oct. 10.6
Feb. 2.7
Aug. 1.9
ANEMIA, ALL FORMS
DISEASES OF THYROID GLAND
Dec. 1.7
Oct. 1.1
Mar. 1.4
June .44
DIABETES MELLITUS
OTHER NONINFECTIOUS GENERAL DISEASES
Apr. 3.3
Dec. 1.9
ARTHRITIS, CHRONIC RHEUMATISM, AND RELATED DISEASES OF ORGANS OF MOVEMENT
Jan. 27.3
Aug. 18.5
NEPHRITIS AND OTHER KIDNEY DISEASES
Nov. 9.0
Aug. 7.8
Nov. 4.9
Apr. 3.6
CYSTITIS AND OTHER URINARY DISEASES
RASH
Apr. 3.8
Oct. 2.2
Feb. 14.0
May 11.8
HEADACHE
OTHER AND ILL-DEFINED DISEASES
Apr. 19.5
July 16.4
F M A M J J A S O N D J F M A M J J A S O N
J J A S O N D J F M A M J J A S O N D
A M J J A S O N D J F M A M J J A S O
MONTH
MONTH
MONTH

Trends of Illness and Mortality Among Civilians and in the Armed Forces

Data on trends of illness and medical care in the civilian population are hard to find. Thus far, illness surveys have been undertaken to study particular situations rather than with any definite idea of obtaining uniformity and comparability of findings in a series of such surveys. Thus, these surveys give little or no accurate information on trends of illness such as one gets in mortality from the continuous registration of deaths. Even the trend of hospital care can be estimated only for a closed population or for the country as a whole because few, if any, civilian hospitals or groups of hospitals can know accurately the extent of the population from which they draw patients. However, the several branches of the armed forces keep continuous counts of the numbers of their active duty personnel with records of illness and medical care among them; thus, they are able to compute reasonably accurate trends of illness and hospitalization among persons in these services. Such trends of illness and hospitalization as are available are of definite interest.

Hospital Care

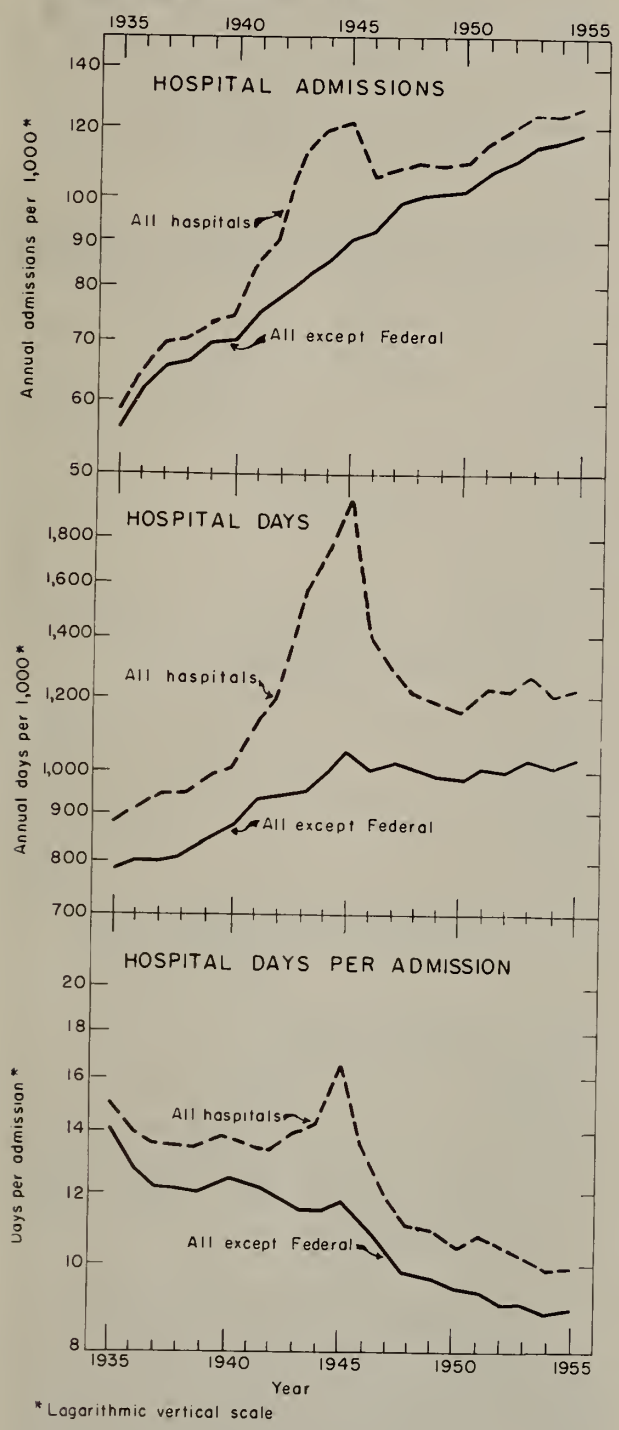
From the annual collection of data from all registered hospitals in the United States during a period of more than two decades by the American Medical Association, and now by the

Table 2. Trends of admission to and days of care in various types of hospitals, United States, 1935–55

Year	Annual hospital admissions per 1,000 population [1]				Annual hospital days per 1,000 population [1]				Hospital days per admission [1]			
	Mental and nervous hospitals	Tuberculosis hospitals	Other general and special hospitals		Mental and nervous hospitals	Tuberculosis hospitals	Other general and special hospitals		Mental and nervous hospitals	Tuberculosis hospitals	Other general and special hospitals	
			Including Federal	Excluding Federal			Including Federal	Excluding Federal			Including Federal	Excluding Federal
1935	1.36	0.68	59	56	1,455	174	882	786	1,070	257	15.0	14.1
1936	1.44	.77	65	62	1,496	180	913	795	1,036	233	14.0	12.8
1937	1.52	.79	69	66	1,550	184	943	794	1,020	232	13.6	12.1
1938	1.53	.78	70	67	1,581	186	948	816	1,033	240	13.5	12.2
1939	1.45	.69	73	70	1,609	183	987	848	1,107	264	13.5	12.1
1940	1.44	.69	74	70	1,634	185	1,021	871	1,133	269	13.7	12.4
1941	1.57	.76	85	75	1,654	194	1,133	931	1,055	254	13.4	12.3
1942	1.59	.75	91	79	1,653	190	1,218	942	1,039	252	13.3	11.9
1943	1.56	.68	112	83	1,688	178	1,560	951	1,083	260	13.9	11.5
1944	1.71	.67	119	87	1,704	174	1,700	992	998	261	14.3	11.5
1945	1.89	.65	121	90	1,726	165	1,994	1,059	916	253	16.5	11.7
1946	1.94	.71	106	92	1,659	162	1,413	1,010	856	227	13.4	10.9
1947	2.01	.69	108	99	1,658	159	1,280	1,030	815	231	11.9	10.4
1948	2.09	.72	110	102	1,660	166	1,215	1,004	795	230	11.1	9.8
1949	2.07	.76	109	102	1,657	171	1,179	990	800	224	10.8	9.7
1950	2.03	.75	110	103	1,659	175	1,165	981	817	233	10.6	9.5
1951	2.00	.70	116	107	1,660	175	1,243	1,007	829	251	10.7	9.4
1952	2.00	.71	119	110	1,650	176	1,212	1,002	823	250	10.5	9.1
1953	2.07	.69	123	114	1,659	173	1,291	1,051	800	252	10.1	9.1
1954	2.09	.68	123	115	1,650	157	1,232	1,028	790	232	10.0	8.9
1955	2.17	.67	125	117	1,645	146	1,237	1,049	758	219	9.9	8.9

[1] 1935–53: Computed from data in Hospital Numbers of the *Journal of the American Medical Association;* 1954 and 1955: Computed from *Hospitals*, August 1955, part II, August 1956, part II. Comparison of J. A. M. A. 1953 and American Hospital Association 1954 data indicated that the differences were negligible.

Figure 21. Trends of rates of hospital admissions, hospital days, and days per admission for all hospitals except mental and tuberculosis, and for all hospitals except mental, tuberculosis, and Federal, United States, 1935–55 (*52, 53*).



American Hospital Association (*52, 53*), it is possible to estimate the trend of hospital care in the United States as a whole. Three types of measures are available for each of three types of hospitals, namely, annual hospital admissions per 1,000 population, annual hospital days of care per 1,000 population, and hospital days per admission; for general and allied special short-term hospitals, for long-term mental hospitals, tuberculosis hospitals, and hospitals for other chronic diseases.

Figure 22. Trends of the percentage of live births and of all deaths that occurred in hospitals, United States, 1935–55 for live births, 1935–49 for deaths.

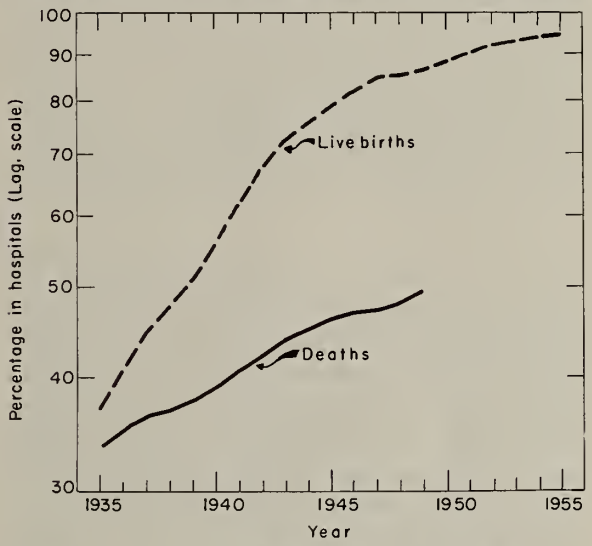


Table 3. Trend of registered live births and of deaths that occurred in hospitals in the United States, 1935–55

Year	Percentage of births and deaths in hospitals		Year	Percentage of births and deaths in hospitals	
	Live births	Deaths, all ages		Live births	Deaths, all ages
1935	36. 9	33. 7	1946	82. 4	46. 9
1936	40. 9	35. 1	1947	84. 8	47. 2
1937	44. 8	36. 7	1948	85. 6	48. 1
1938	48. 0	37. 0	1949	86. 7	49. 5
1939	51. 1	37. 7	1950	88. 0	----
1940	55. 8	39. 0	1951	90. 0	----
1941	61. 2	40. 8	1952	91. 7	----
1942	67. 9	42. 3	1953	92. 8	----
1943	72. 1	44. 1	1954	93. 6	----
1944	75. 6	45. 4	1955	94. 4	----
1945	78. 8	46. 3			

SOURCE: National Office of Vital Statistics.

Short-Term Hospitals

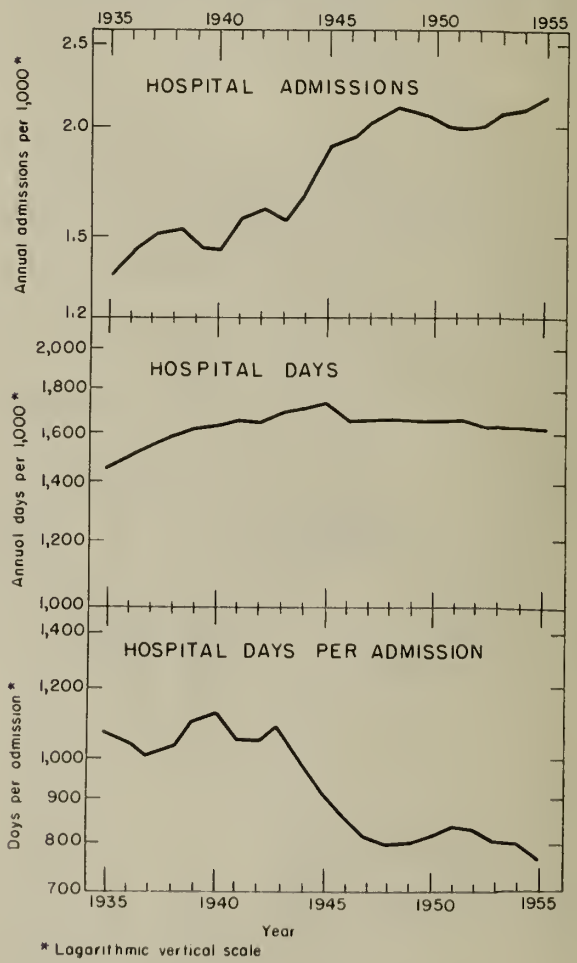
Figure 21 and table 2 show trends of the three measures of hospital care from 1935 through 1955. Federal hospital care (Armed Forces, Public Health Service, and Veterans Administration) was so increased during the Second World War that the long-time trend is seen only when Federal hospitals are excluded from the computations. As the vertical scales are logarithmic, the slopes indicate relative increases or decreases. Thus, admissions, exclusive of those to Federal hospitals, have increased on almost a straight line (log scale) and at a considerably more rapid rate than days of hospital care. Among the important causes of the large increase in hospital admissions over these two decades must be the increase in the various types of prepaid hospital care. However, hospital days per admission to non-Federal hospitals have declined from 14.1 days in 1935 to 8.9 days in 1955, or 37 percent (fig. 21, bottom section).

Data on two other specific items refer to births and deaths occurring in hospitals. In the total population of the United States, the proportion of all births that occurred in hospitals increased from 37 percent in 1935 to 94 percent in 1955, an increase of 154 percent in the 20 years. The percentage of all deaths in hospitals increased from 34 in 1935 to 50 in 1949, a proportionate increase of 47 percent in 14 years, compared with 135 percent increase of births in hospitals during the same 14 years. Tabulation of deaths in hospitals was discontinued after 1949 (fig. 22 and table 3).

Long-Term Mental Hospitals

Figure 23 and table 2 show trends of admissions to and days of care in mental hospitals for the same period as for short-term hospitals. These admissions increased only from 1.36 in 1935 to 2.17 per 1,000 population in 1955, but this represents an increase of 60 percent. However, hospital days per admission are so great in mental hospitals that the total days of care increased from 1,455 to 1,645 days per 1,000 population in the same period but with an increase of only 13 percent. Thus, figure 23 (log scale) shows that the relative or percentage increase in admissions has been rapid, and that during the years 1943 to 1948 the days per admission decreased rapidly, but the large item of days of care in mental hospitals per 1,000 population increased by only a small percentage. After about 1948, hospital admissions per 1,000 population and days per admission tend to level off, with relatively little change in these rates. This is approximately true of annual hospital days per 1,000 population after 1946.

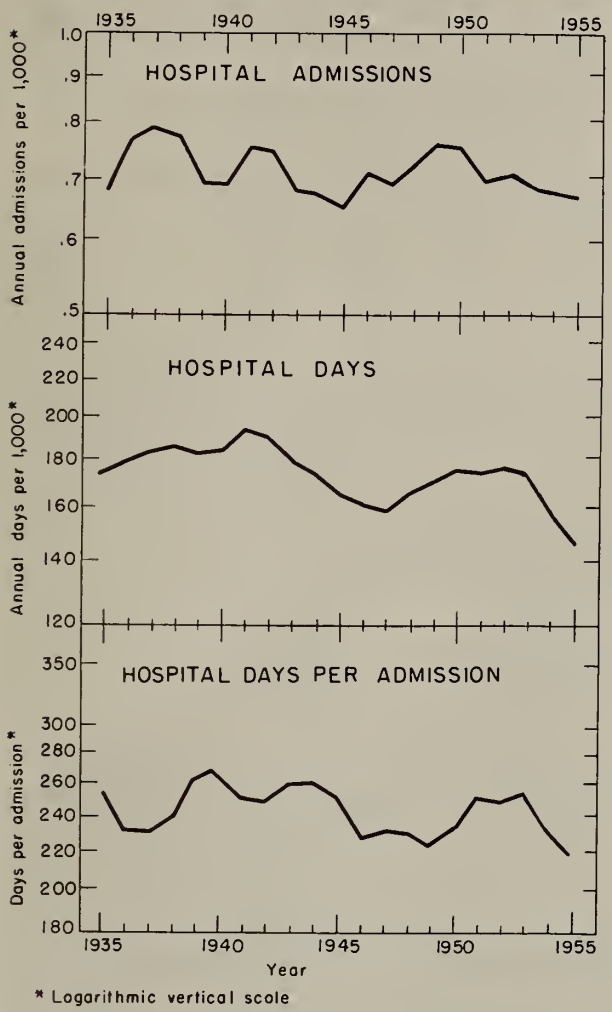
Figure 23. Trends of rates of hospital admissions, hospital days, and days per admission to long-term mental hospitals, United States, 1935–55 (*52, 53*).



Long-Term Tuberculosis Hospitals

Admissions to tuberculosis hospitals are also few compared with hospital days per 1,000 population and hospital days per admission, and both of these items are much smaller than the corresponding ones for mental hospitals (fig. 24 and table 2).

Figure 24. Trends of rates of hospital admissions, hospital days, and days per admission to long-term tuberculosis hospitals, United States, 1935–55 (*52, 53*).



In tuberculosis hospitals, neither admissions nor days per admission show much long-time trend but both show more or less irregular waves. Hospital days per 1,000 population rise from a low of 174 in 1935 to a peak of 194 in 1941, decline to 159 in 1947, and rise again to 176 in 1952, with a drop to 146 in 1955. Hospital days per admission fluctuate from 269 in 1940 to 224 in 1949 and 219 in 1955, with little or no downward or upward long-time trend.

Trends of Tuberculosis Mortality, by Age

One way to show trends of death rates from a given disease is to plot age-specific mortality rates from the disease for different chronological periods and to consider the change in the height of the curves for different specific ages (*54*). Figure 25 and table 4 show such data for tuberculosis in which each age curve represents annual rates for a 3-year period around each of the six decennial censuses, from 1900–1902 to 1949–51 (*69*). None of these curves for the 6 time-periods cross any other curve; thus at each of the 11 ages for which data are plotted, the rate decreased consistently during the chronological intervals between the 6 census periods. For example, among males 25–34 years of age the tuberculosis death rate decreased in the half century from 282 to 12 per 100,000 population or 96 percent, and at 65–74 years the tuberculosis death rate among males decreased from 268 to 84 per 100,000 population, or 69 percent. Corresponding data for the same ages and time periods for females are decreases at 25–34 years of age from 278 to 13 per 100,000 population or 95 percent, and at 65–74 years from 220 to 27 per 100,000 population or 88 percent.

Chronic Diseases

The trend of deaths from chronic disease is easily measured because death occurs but once. But illness from a chronic disease varies at different times from the ability to continue at the patient's usual occupation for months or even years, to confinement to bed or to a hospital for long periods, or death. How, then, can we measure chronic diseases? In this and some similar reports, chronic disease has been measured by the number of episodes of illness due to the chronic disease. One advantage of this method of counting episodes or attacks of chronic disease is that these episodes are similar to attacks of acute diseases, except that repeated attacks of acute diseases are generally unrelated in the sense that the patient recovers completely from each attack. The chronic patient's series of attacks, on the other hand, usually leaves him still with the chronic disease and sometimes with an added liability to more frequent attacks. However, it is important to count patients with specific chronic diseases as well as to count attacks of disease.

The study of illness in the Eastern Health District of Baltimore was continued for only 5 years, but some interesting data on chronic

disease trends for that period are available. Table 5 shows the number of persons with chronic disease at any time during a study year (ending May 31) per 1,000 persons under observation in December—the approximate middle of each study year. The data were further subdivided into numbers of persons with chronic disease who were disabled in the sense of being unable to be about their usual activities at some time during the study year, and those whose chronic disease did not keep them from work or other usual activities at any time during the year.

The number of patients with any chronic dis-

Figure 25. Annual age- and sex-specific death rates from tuberculosis, all forms, for 3-year periods around six decennial censuses, 1900–1950—United States death registration States (*69*).

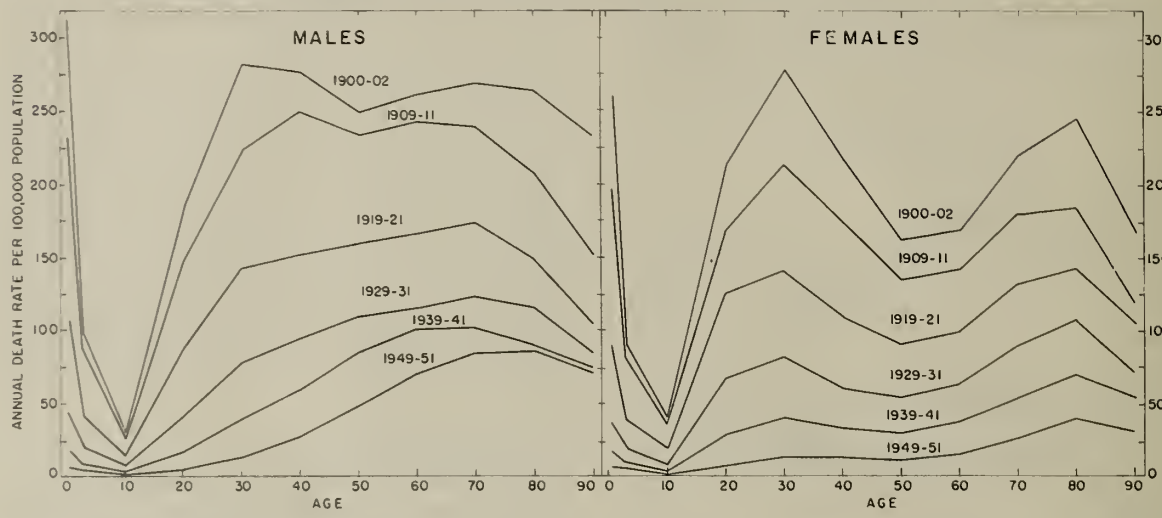


Table 4. Annual age-specific death rates from tuberculosis, all forms, per 100,000 males and females during 3-year periods around each decennial census, expanding death registration States,[1] 1900–1902 to 1949–51

Periods	All ages	Age										
		Under 1 year	1–4	5–14	15–24	25–34	35–44	45–54	55–64	65–74	75–84	85 and over
	Male											
1900–1902	195.3	312.8	98.0	28.8	178.7	282.4	276.9	249.3	260.6	268.1	262.6	234.2
1909–1911	168.3	232.3	87.7	25.9	144.5	223.0	248.7	234.3	242.1	238.7	207.6	151.0
1919–1921	101.8	107.3	42.2	14.2	87.1	142.7	152.4	158.5	166.4	173.8	148.6	103.8
1929–1931	63.5	43.8	20.7	6.5	40.7	77.6	95.2	108.6	114.8	123.1	115.1	84.4
1939–1941	41.2	18.1	9.3	2.9	17.2	39.0	58.3	84.4	100.1	100.8	89.4	72.6
1949–1951	25.4	5.6	4.2	1.0	4.7	12.3	26.0	45.9	69.8	83.6	85.1	70.8
	Female											
1900–1902	177.1	260.1	91.4	40.9	213.8	277.8	218.0	161.9	168.7	219.9	244.5	168.5
1909–1911	141.1	196.7	81.2	36.0	168.3	213.7	174.7	135.3	141.7	181.4	184.6	119.8
1919–1921	91.8	89.1	37.5	18.6	124.5	141.4	111.2	90.8	99.8	132.2	143.3	106.4
1929–1931	52.6	37.1	18.9	8.0	67.0	81.8	59.6	53.8	63.2	89.7	108.3	73.2
1939–1941	28.8	17.2	9.3	3.6	27.8	41.1	33.4	29.6	37.8	55.0	69.8	55.7
1949–1951	11.3	5.7	4.6	1.1	6.9	12.9	13.7	12.3	15.7	26.6	40.5	31.8

[1] All races for periods 1900–1902 and 1909–11; white only for 1919–51; nonwhite population in the registration States was small during the first decade of the existence of the registration area.

Table 5. Chronic diseases among persons under observation in December of each study year—Baltimore Eastern Health District Morbidity Study, June 1, 1938–May 31, 1943

Study year	Persons with chronic disease [1] per 1,000 observed population			Ratio to rate for 1st year (1st year=100)			Number of persons with—			Total persons observed in December
	Any chronic disease	Disabling chronic disease	Nondisabling chronic disease	Any chronic disease	Disabling chronic disease	Nondisabling chronic disease	Any chronic disease	Disabling chronic disease	Nondisabling chronic disease	
First	128. 7	51. 5	77. 2	100	100	100	735	294	441	5, 709
Second	144. 0	51. 7	92. 3	112	100	120	808	290	518	5, 612
Third	156. 3	54. 0	102. 3	121	105	133	793	274	519	5, 074
Fourth	182. 4	63. 4	119. 0	142	123	154	[2] 483	[2] 168	[2] 315	[2] 2, 648
Fifth	187. 1	52. 5	134. 6	145	102	174	[2] 474	[2] 133	[2] 341	[2] 2, 533
Average [3]	159. 7	54. 6	105. 1							

[1] Exclusive of persons in tuberculosis and mental institutions throughout a study year.

[2] For purely administrative reasons, half the original sample of blocks were dropped at the end of the third year of the study. The blocks to be dropped were selected on a random basis, so the percentages, rates, and averages for the 4th and 5th years in the several tables are based on the retained blocks only.

[3] Simple average for the 5 years.

Table 6. Death rates and recovery rates among persons with chronic disease: Baltimore Eastern Health District Morbidity Study, June 1, 1938–May 31, 1943

	1st study year	2d study year	3d study year	4th study year [1]	5th study year [1]	All 5 study years
Total persons with 1 or more chronic diseases [2]	936	1, 009	1, 016	581	556	[3] 4, 098
Disabled	399	405	376	217	177	[3] 1, 574
Nondisabled	537	604	640	364	379	[3] 2, 524
Disabling chronic cases:						
Prior onset (in study, 1st visit)	293	218	200	109	105	925
Prior onset (moved into study)	24	36	31	13	9	113
New cases (onset within)	82	75	59	35	19	270
Newly disabled (from nondisabled)		76	86	60	44	266
Moved out (disabled this year)	39	47	38	14	23	161
Full-time years of observation as disabled chronics	390	355	329	184	162	1, 420
Deaths from chronic disease	48	44	36	21	14	163
Annual deaths per 1,000 persons with disabling chronic diseases	123. 1	123. 9	109. 4	114. 1	86. 4	114. 8
Recovery [4] from disabling chronic diseases	3	3	5		2	13
Annual recoveries [4] per 1,000 persons with disabling chronic diseases	7. 7	8. 5	15. 2		12. 3	9. 2
Deaths from nonchronic causes among persons with disabling chronic diseases		1	3	2	5	11
Annual nonchronic deaths per 1,000 persons with disabling chronic diseases		2. 8	9. 1	10. 9	30. 8	7. 7
Nondisabling chronic cases:						
Prior onset (in study, 1st visit)	410	405	434	273	281	1, 803
Prior onset (moved into study)	61	64	53	33	19	230
New cases (onset within)	66	48	47	23	10	194
Nondisabling this year (from disabling)		87	106	35	69	297
Moved out (nondisabling this year)	45	69	64	41	44	263
Full-time years of observation as nondisabled chronics	497	546	571	339	353	2, 306
Recovery [4]		5	2			7
Annual recoveries [4] per 1,000 persons with nondisabling chronic diseases		9. 2	3. 5			3. 0

[1] Numbers are less in the last 2 years of the study because half of the blocks were dropped for administrative reasons; the blocks to be dropped were chosen on a random basis.

[2] Includes persons in long-term institutions as well as those in short-term hospitals and those not in any hospital.

[3] Years of observation in the study.

[4] "Recovery" means that the person became free of all chronic diseases.

ease increased from 129 to 187 per 1,000 population, or 45 percent, during the 4-year interval between the middle of the first and fifth years of the study (table 5). However, the number of nondisabled chronic patients increased from 77 to 135 per 1,000 population, or 74 percent, but the number of the disabled chronic patients increased from 51 to 63 per 1,000 population, or only 23 percent, between the first and fourth study years, but dropped to 52 per 1,000 in the fifth year, or only 2 percent increase over the first year. Thus it appears that, at least in this population, there was a large increase in the minor chronic impairments that did not interfere with work, school, or other usual activities, but a much smaller increase in the chronic diseases that interfered with usual activities at some time during the study year. Such a situation could reflect partial cures of persons with disabling chronic disease that enabled them to pursue work or other usual activities without interruption, but it could also mean that minor chronics are increasing rather rapidly in the population or that major chronics are being cured or are dying about as fast as the diseases are developing in other persons.

Table 5 shows rates for disabling and for nondisabling chronic diseases. In the course of the study, some persons passed from the nonsick group to the status of a nondisabled chronic and some passed directly into the status of a disabled chronic. Table 6 is a tabulation of the number of chronic patients who moved into the study during each year; the new chronic cases among persons already in the study group; the number of chronics who moved out of the study during the year; and, finally, the number who recovered from and the number who died from chronic disease during each year.

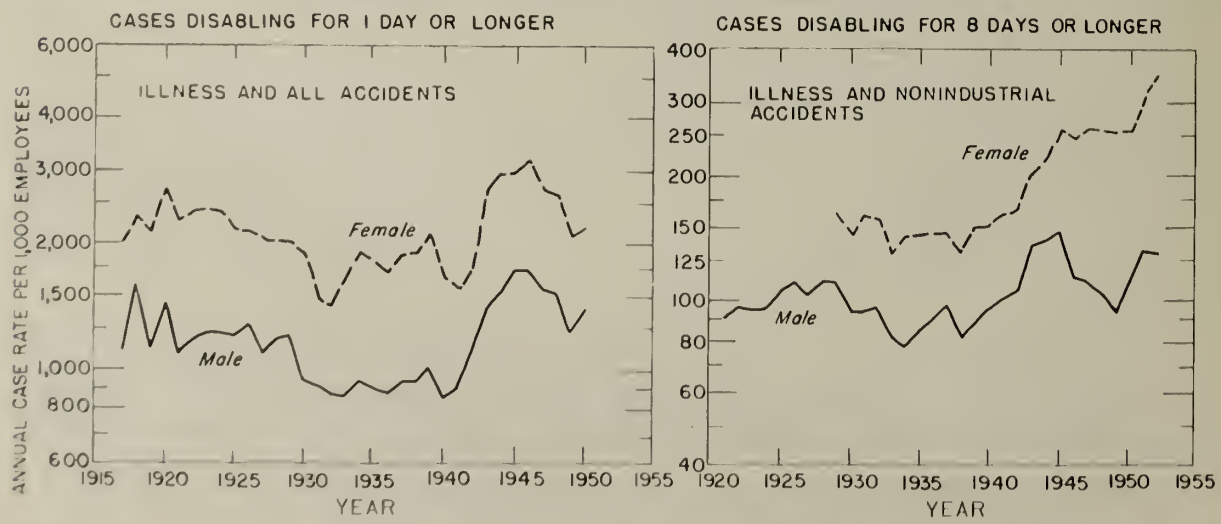
Considering only the total for all 5 years, there were approximately 1,420 full-time years of observation for patients disabled from chronic diseases at some time during the year, with an annual death rate during that time of 115 per 1,000 persons with disabling chronic disease and a recovery rate of 9.2 per 1,000. It must be remembered, however, that most of the chronic patients are in the older ages where death rates are high among the nonchronic patients also.

Data for nondisabled chronic patients show 2,306 full-time years of observation; in this group, there were 3.0 recoveries per 1,000 years of observation of nondisabled chronic patients.

Sickness Among Industrial Workers

Figure 26 shows trends of sickness and accidents among groups of male and female industrial workers (*55*). The chart on the left shows illnesses and accidental injuries causing absences of 1 day or longer, and on the right, illnesses and nonindustrial accidents causing

Figure 26. Trend of illness among industrial employees, 1917–50, for cases disabling for 1 day or longer, and 1921–52 for cases disabling for 8 days or longer (*55*).



absences of 8 days or longer. The annual rates for cases lasting 1 day or longer fluctuate from 1,433 to 3,254 per 1,000 women, compared with 859 to 1,775 for men. However, the annual rate of serious cases causing disability of 8 days or longer fluctuates from 130 to 345 cases per 1,000 women, and for men from about 78 to 147. In both severities of cases, the rates rise to a peak in the year 1946, with some drop by 1950 in cases lasting 1 day or longer, but the rates for cases lasting 8 days or longer are still high in 1952, especially for women. No data on these two series are available after 1952. Presumably the rise in illness rates beginning around 1940 is associated with the Second World War effort, during which many new employees were added by industrial establishments. New employees usually suffer more frequent illness than seasoned employees.

Illness and Mortality in the Armed Forces

Records of illness (admissions to sick report) among the active-duty personnel of the Army are available back to 1819, and those for the Navy back to 1865. Although the definition of illness that involved admission to an Armed Forces hospital or to outpatient medical treatment must have varied during these long periods, systematic records were kept of the total active-duty personnel and of the numbers admitted to sick report by medical officers of the various military and naval organizations. Annual reports of the numbers and rates of illness, by diagnosis, for the whole of each of the three armed services were prepared and published under the direction of the Surgeons General of the Army (*56*), Navy (*57*), and Air Force (*58*) and are still available for practically all the years covered. However, the Air Force has been in existence as a separate unit for too short a time to make long-time trend studies worth while.

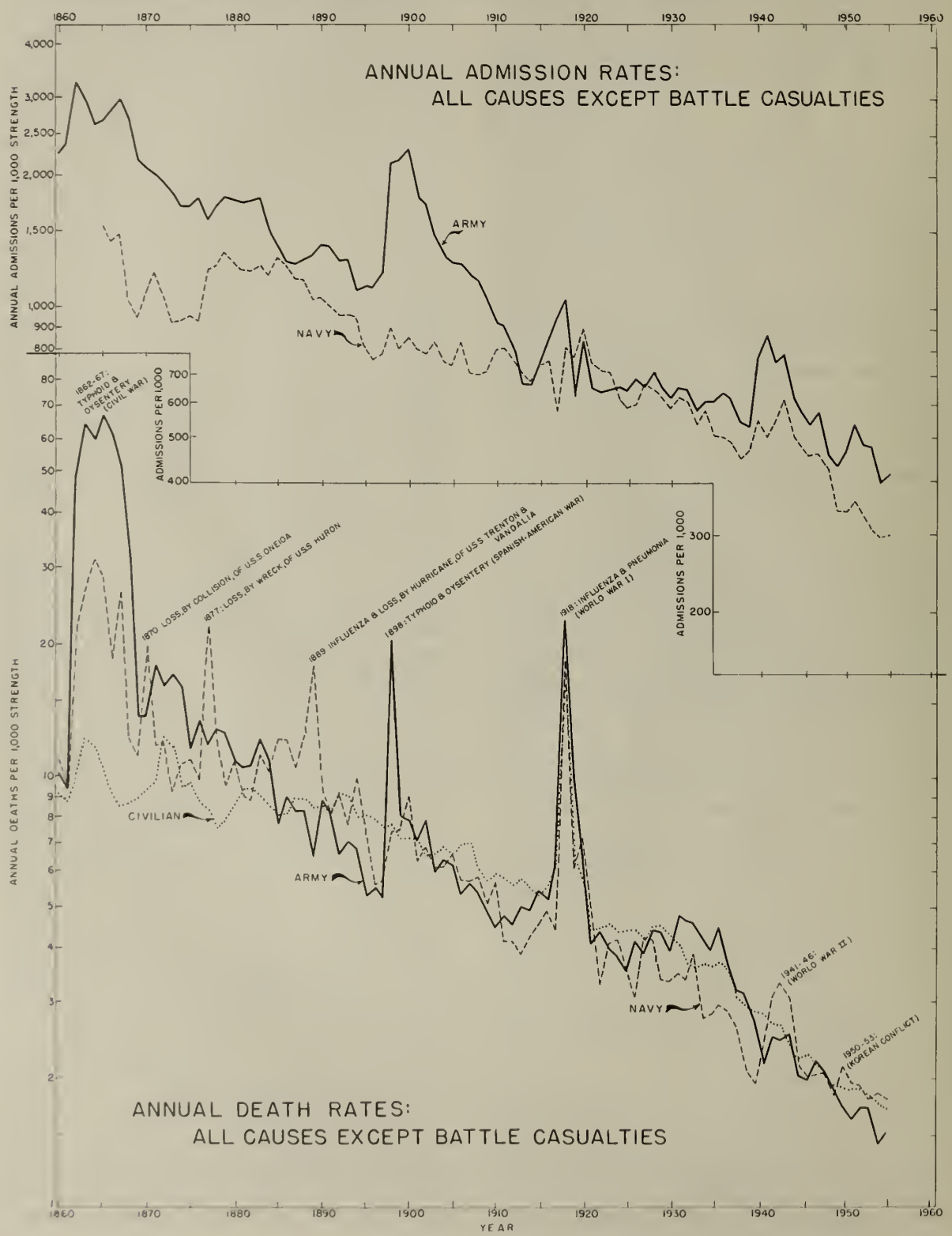
Figure 27 (top) shows a year-by-year record of illness in the Army for the 96 years from 1860 to 1955, inclusive, and a similar record for the Navy for all except the first 5 years of that period. A few blanks in the records of illness in the armed services have been estimated from adjacent years or from other types of records included in the reports.

The lower part of figure 27 shows annual death rates for the whole period for both the Army and the Navy, together with a record of civilian death rates of males of the approximate Army and Navy ages in the expanding death-registration States from 1900 to 1955, and for Massachusetts from 1899 back to 1860.

In the United States death-registration States, the published death rates for males aged 15–24 and 25–34 were averaged as approximating the average age of the armed services personnel; in Massachusetts, the death rates were published for the ages 15–19, 20–29, and 30–39; weighted averages of rates at these ages were made with weights of 1, 2, and 1, respectively. As a check, average rates of this kind were made for Massachusetts for 1900, 1905, 1910, and 1915, and compared with averages for the death-registration States for the same years; the average rates for Massachusetts and for the registration States were very similar and showed the same trend.

The death rates plotted in the lower part of figure 27 show high peaks in Army deaths in the three major wars prior to 1920, in spite of the fact that these data exclude battle casualties. During the Civil War and the Spanish-American War, typhoid fever and dysentery were the great disease killers. Death rates in the Navy were also rather high during the Civil War. However, the high 1898 typhoid peak in the Army has no counterpart in the Navy, where there was little exposure to such diseases; the deaths from typhoid were largely in the Army camps within the United States and in the Philippine Islands during the Philippine Insurrection. The several peaks in Navy deaths between the Civil War and the Spanish-American War were due to the sinking of vessels by storms, collisions with other vessels, and other nonbattle disasters. The large peak in 1918, which reflects the situations in the Army, Navy, and among civilians represents the great influenza-pneumonia pandemic of 1918–19, which was excessively destructive. For about a decade or slightly longer after the 1918–20 influenza epidemics, the Army, Navy, and civilian death rates fluctuated around rather level lines, but by 1935 the trend of all three

Figure 27. Trends for nearly a century of annual rates of illness and death in the U. S. Army and Navy, and among civilian males of comparable ages; all causes except battle casualties and disasters such as deaths from sinking of ships by storms and nonbattle collisions, 1860–1955 (*56, 57, 69*).



death rates had begun a moderately steep drop which was only partially interrupted by small peaks in the rates for the armed services during the Second World War and to a slight extent during the Korean conflict.

In contrast to the death rates, the peaks in illness rates (upper half of fig. 27) are relatively lower but broader. For example, the Army mortality peak of 1898 during the Spanish-American War pertains to 1 year only, but the morbidity peak lasted for 3 years, and it was nearly a decade before the rate again reached the expected level on the basis of the prior trend of illness. The 1918 peak of influenza cases is not so much higher than the World War II peak of 1941, in spite of the tremendous death rate in 1918.

Prior to about 1885, the Army mortality rates were highest; Navy rates second; and civilian rates lowest. But aside from sharp peaks in Army and Navy death rates, the three sets of such rates in the lower part of figure 27 follow roughly the same general trend from about 1885 to 1955. These trends suggest that trends of sickness and nonbattle injury in the armed services are similar to trends of diseases and accidents in the civilian population of comparable ages. Thus, it may be tentatively assumed that trends of sickness and injury among young adult males in the civilian population are roughly similar to sickness and nonbattle injuries in the armed services.

Trends of Illness and Death Rates

The civilian death rates have few of the sharp peaks that occur in rates for the armed services, the 1918 influenza-pneumonia pandemic peak being the only sizable one (fig. 27). The two moderately high death rates for civilians from 1860 to 1875 are not real peaks but waves that cover 5 or more years rather than 1 or 2 years.

Death rates have declined somewhat more rapidly than case rates (fig. 28). To make a more clear-cut comparison, both sets of rates have been averaged in 10-year groups, but the high peaks which represent unusual conditions such as epidemics and disasters as well as battle casualties have been omitted. Data for some years not shown in the official reports because of unreliability or war conditions are generally excluded also from the 10-year averages. These data have been estimated from previous and following years or from other types of data reported by the Armed Forces, and data for periods of less than 10 years are used as a basis for averages of more or less normal values.

These 10-year averages of normal rates for nonbattle causes of illness and death in the armed services, mostly for peacetime years, afford a comparison of the slope (logarithmic vertical scale) of the sickness rate with that of the death rate in the same branch of the armed services and with the slope of the death rate among civilians of approximately the same ages for whom few illness records are available.

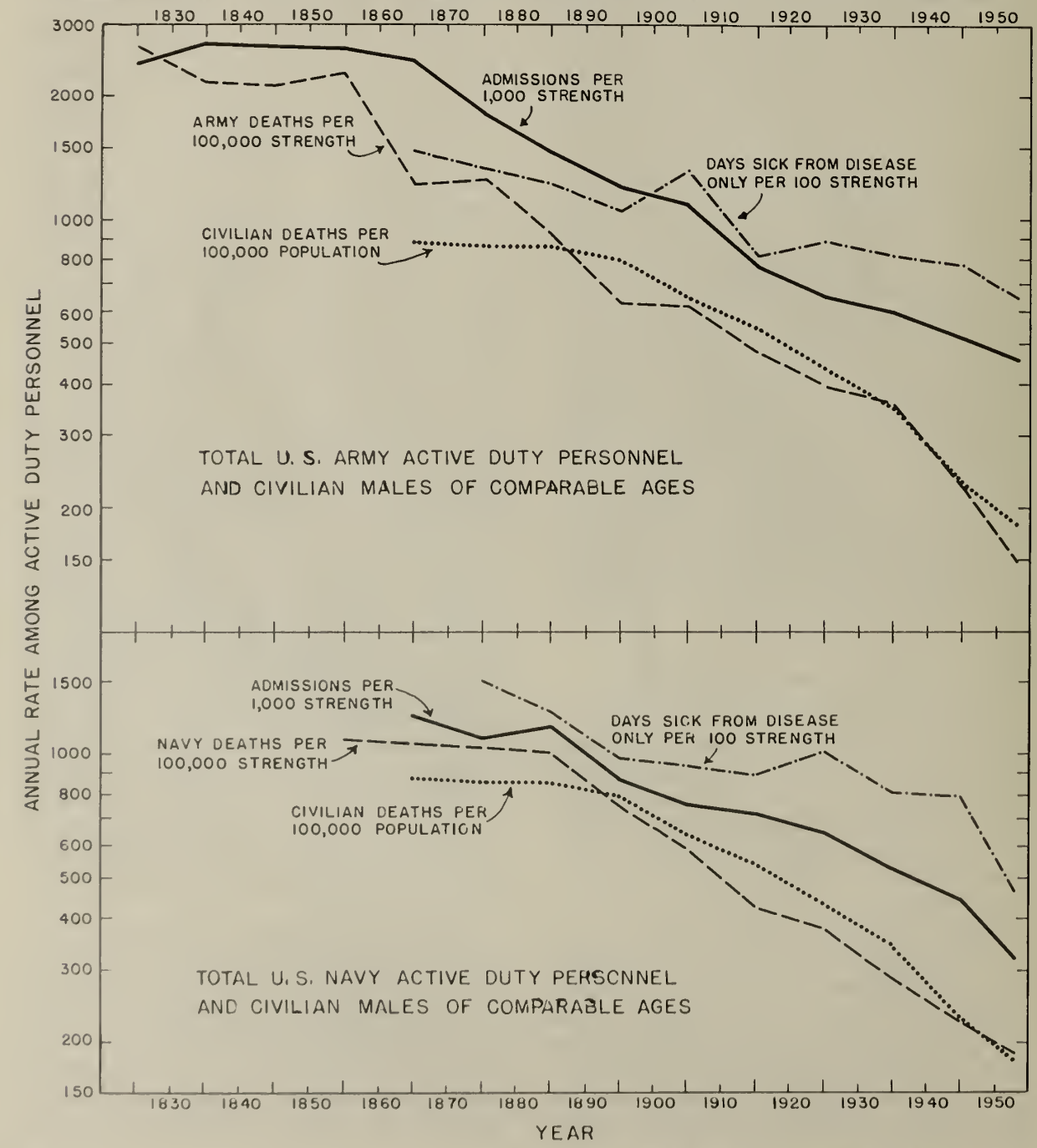
Both Army and Navy death rates from all causes except battle casualties have decreased more rapidly than illness rates for the same cause groups (fig. 28). Also, death rates from "disease and accident" among civilian males of comparable ages have decreased at a rate approaching more closely that of death rates in the Army and Navy than of illness rates in those organizations. If the above observations are true, it would appear reasonable to assume that in the civilian population also, death rates have declined at a relatively more rapid rate than illness rates. Although no longtime trends of civilian illness rates are available, some less specific data support the same hypothesis. For example, some communicable diseases, such as diphtheria, for which both immunization and effective therapeutic agents are available, have declined more rapidly than others for which only one of these methods is available. For such a disease, there are two available methods of saving lives—by preventing cases and by preventing deaths of patients in whom the diseases do occur, compared with one method where only one of these two procedures is available.

The left half of figure 29 shows the trend of death rates from disease, exclusive of accidents and battle casualties, for Army enlisted personnel stationed in the continental United States and Alaska, and for the entire Navy. Death rates for civilians are the death rates for males of approximate military ages in the expanding death-registration States from 1900 to

1955; prior to 1900, the civilian mortality data are for males of approximate military ages in Massachusetts (for ages used to obtain a civilian group of approximate average age of active-duty Armed Forces personnel, see page 33).

Death rates from disease and accident among civilian males of approximate average military ages were on the same general level as death rates from nonbattle causes among men in the Army and Navy. However, figure 29 shows that from about 1885 to 1955 the death rates

Figure 28. Long-time average trends in the U. S. Army and Navy of annual rates of admissions to sick report, annual days sick, and annual deaths, all exclusive of the results of battle casualties and exceptionally high peaks of illness and death due to epidemics, nonbattle loss of ships, and other disasters, 1830–1953.

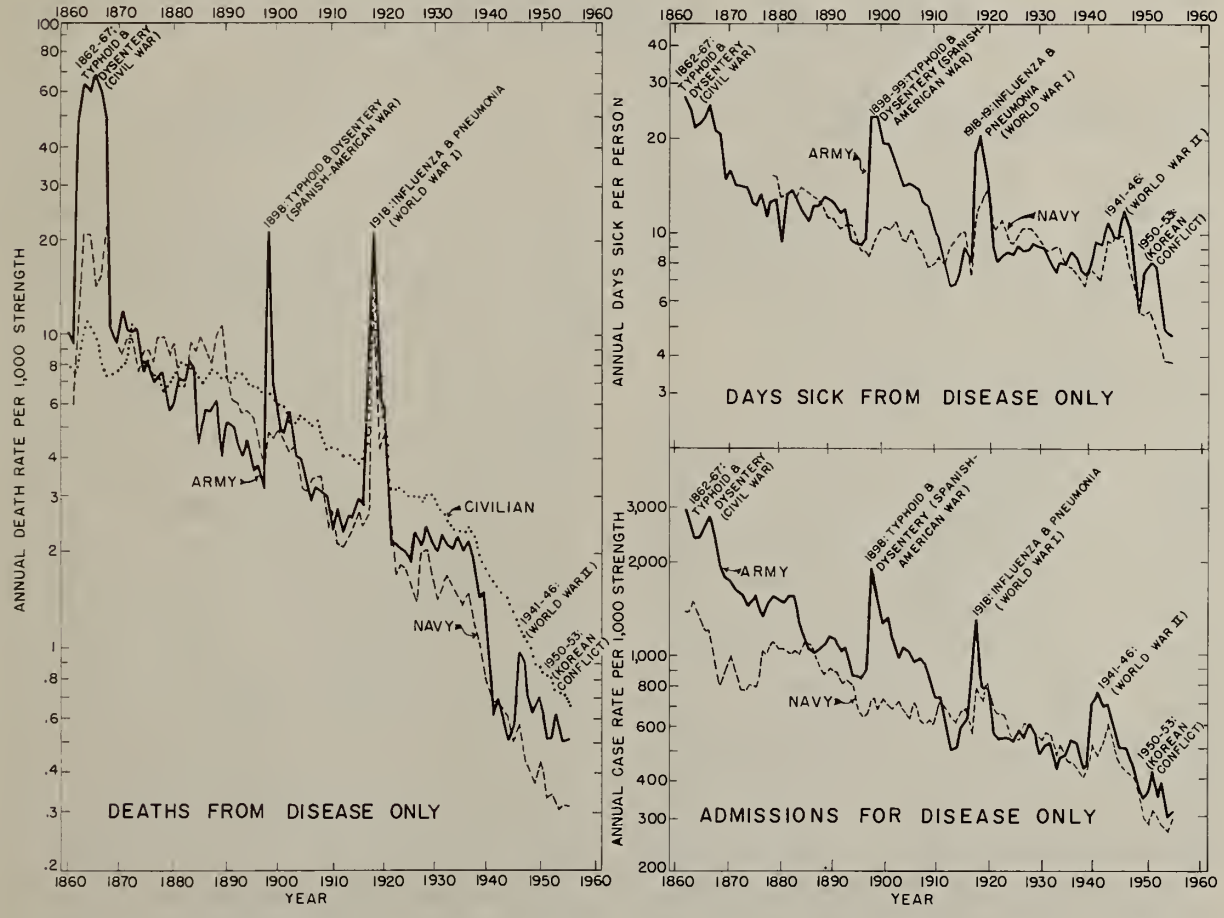


from disease only among civilians of comparable ages are consistently higher than death rates from disease only among Army and Navy enlisted personnel, except during the typhoid epidemic of 1898 in the Army and the influenza-pneumonia epidemics of 1918–20. This reversal from the situation for deaths from disease and accident (exclusive of battle casualties) may be due, at least in part, to the screening out of men with chronic or other long-duration diseases and physical impairments in the careful entrance examinations by the armed services and to the discharge for disability of persons who became physically or mentally unfit for further service because of illness, accident, or battle casualty while in the armed services.

The lower right box of figure 29 shows admissions to sick report for disease only. The Army data has the usual characteristics of data including both accident and disease, such as peaks due to epidemics, but the Navy peaks are less frequent and usually lower than the Army peaks of admissions to sick report for disease only. The Army peak of 1898 was quite sharp, and it was about a decade after the peak before the admission rate returned to the approximate level of an extension of the general trend of the rates when the high and sharp peaks are disregarded. However, the 1918 influenza peak in the Army is more like other epidemic peaks.

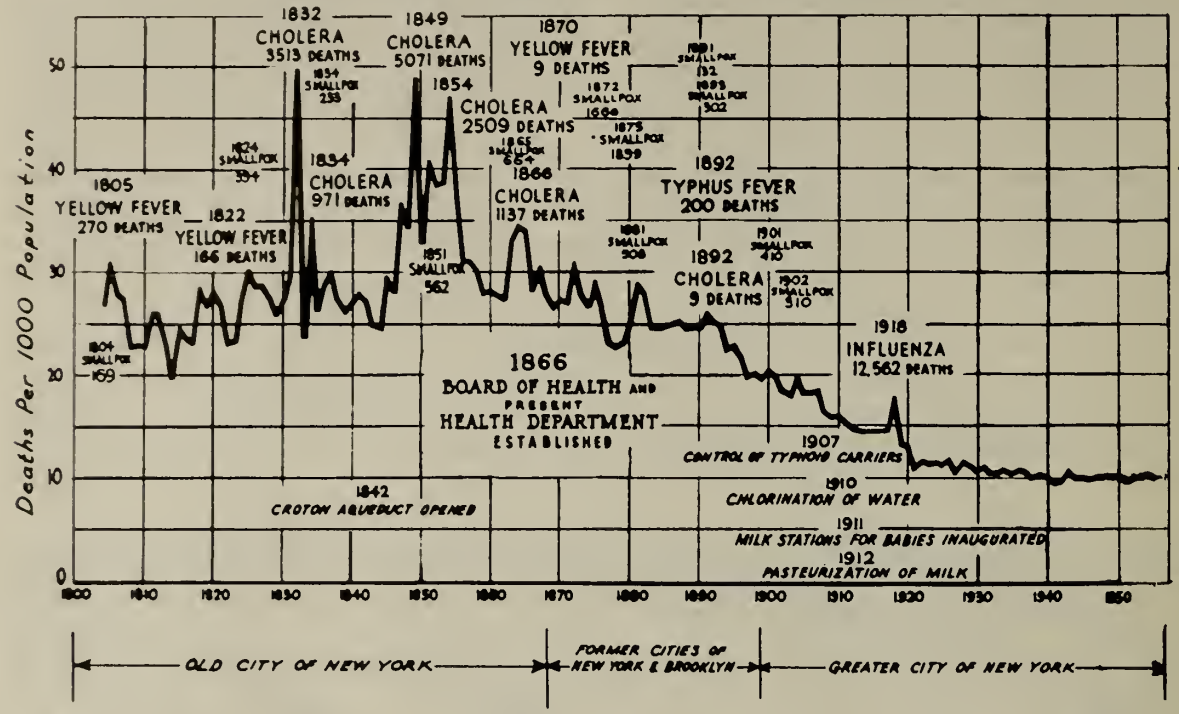
The annual days sick per person, computed from Army and Navy data on noneffectives for disease only are shown in the upper right box

Figure 29. Trends among enlisted men in the U. S. Army stationed in the continental United States and Alaska, and in the entire U. S. Navy, of annual illness rates from disease only, rates of annual days sick from disease only, and annual death rates from disease only, with annual death rates from disease only among civilian males of comparable ages, 1860–1955.


ANNUAL DEATH RATE PER 1,000 STRENGTH
1862-67: TYPHOID & DYSENTERY (CIVIL WAR)
1898: TYPHOID & DYSENTERY (SPANISH-AMERICAN WAR)
1918: INFLUENZA & PNEUMONIA (WORLD WAR I)
ARMY
CIVILIAN
NAVY
1941-46: (WORLD WAR II)
1950-53: (KOREAN CONFLICT)
DEATHS FROM DISEASE ONLY
YEAR
ANNUAL DAYS SICK PER PERSON
DAYS SICK FROM DISEASE ONLY
ANNUAL CASE RATE PER 1,000 STRENGTH
ADMISSIONS FOR DISEASE ONLY
1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960

430176—57——6

Figure 30. Annual death rates from all causes in Greater New York City and its component parts of earlier years, with special reference to pestilential diseases, 1804–1955.


Deaths Per 1000 Population
1832 CHOLERA 3513 DEATHS
1849 CHOLERA 5071 DEATHS
1870 YELLOW FEVER 9 DEATHS
1854 CHOLERA 2509 DEATHS
1834 CHOLERA 971 DEATHS
1866 CHOLERA 1137 DEATHS
1892 TYPHUS FEVER 200 DEATHS
1892 CHOLERA 9 DEATHS
1805 YELLOW FEVER 270 DEATHS
1822 YELLOW FEVER 166 DEATHS
1918 INFLUENZA 12,562 DEATHS
1866 BOARD OF HEALTH AND PRESENT HEALTH DEPARTMENT ESTABLISHED
1842 CROTON AQUEDUCT OPENED
1907 CONTROL OF TYPHOID CARRIERS
1910 CHLORINATION OF WATER
1911 MILK STATIONS FOR BABIES INAUGURATED
1912 PASTEURIZATION OF MILK
OLD CITY OF NEW YORK
FORMER CITIES OF NEW YORK & BROOKLYN
GREATER CITY OF NEW YORK

Note: Populations of the Old City of New York ranged from 96,373 in 1810 to 830,012 in 1860; of Former Cities of New York and Brooklyn from 1,391,194 in 1870 to 2,253,848 in 1890; and of Greater City of New York from 3,437,202 in 1900 to 8,005,000 in 1955.

in figure 29. The trend is much the same as in admissions to sick report except from about 1922 to 1938, when there was little change in the average level of the annual days sick per person, particularly for the Army.

Long-Time Trends in Cities

The health agencies of a few cities have compiled and published annual death rates from all causes for long periods. The New York City Health Department (*59*) has recorded death rates for Greater New York and its predecessor components for about 150 years, back to 1804 (fig. 30). Although data for the very early years may be deficient, the New York City Health Department estimates that the unreported deaths would not exceed 10 percent. The chief reason for introducing this chart at this point is to show that pestilential diseases such as cholera, smallpox, and typhus were still causing some deaths in the last decade of the 19th century and were causing numerous deaths just prior to the Civil War. Thus, the few large epidemics in the armed services were not unusual. However, the general level of death rates is high here because the city includes old and young, sick and well, so death rates are higher than among healthy young men such as those in the armed services.

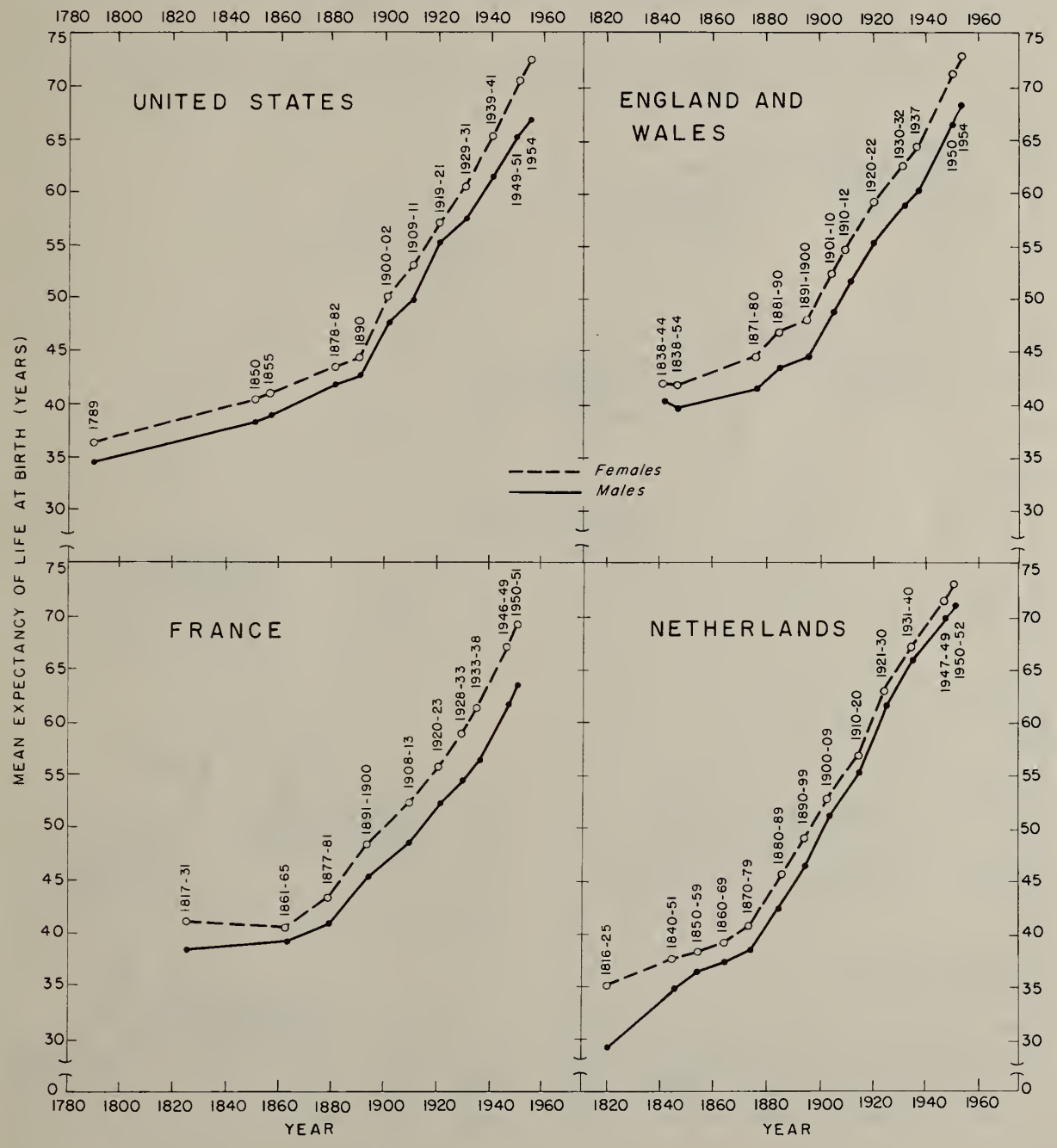
Since 1900, the only extensive epidemic was the influenza pandemic of 1918–19, which seems small compared with cholera epidemics in 1832, 1849, and 1854, with 2,500 to 5,000 deaths. More than 1,000 cholera deaths occurred in 1866. Between 1830 and 1860, cholera outbreaks in three separate years brought the annual death rate from all causes in New York City to 45 or more per 1,000 population. Although the numbers of deaths are smaller, smallpox epidemics are noted eight times between 1824 and 1891. Other pestilential diseases, such as yellow fever, relapsing fever, and typhus, occurred chiefly prior to about 1880. This interesting history of dreaded diseases indicates that civilians as well as the armed services experienced large epidemics of diseases that are now rare in this country.

Life Expectancy

Life expectancies are the figures most usually quoted from life tables. The following definition of life expectancy appears in a report of the Bureau of the Census (*60*): "The complete expectation of life at [birth or] a specified age is the average number of years lived by members of a hypothetical cohort of individuals, assumed to be subject throughout the remainder of their lives to the age-specific mortality rates observed in a given time period."

Inasmuch as the risk of mortality changes with time, and since in the past century the change in most countries has been toward lower

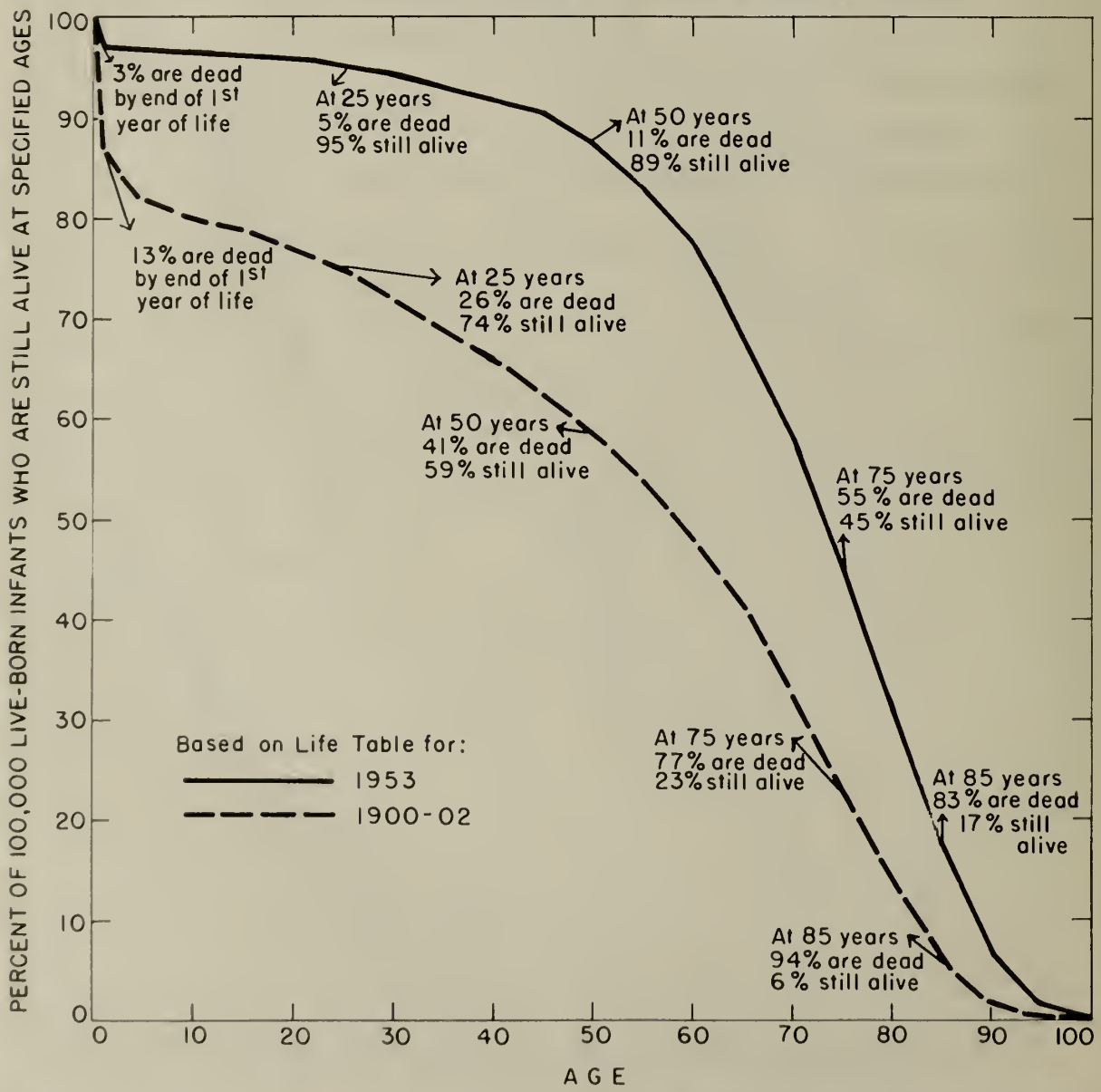
Figure 31. Increase in life expectancy at birth in a period of a century or longer for males and females in the United States and in 3 countries of Western Europe (*63–66*).



death rates, life expectancy based on a given year or a short series of years understates the actual expectancy of the cohort as time passes. To correct for this chronological change in death rates and consequently in life expectancies, the generation life table has been developed, in which life expectancy at different ages of the cohort is computed as that of the chronological year when the cohort reaches the given age. Thus, when death rates are declining and consequently life expectancy is increasing, the life expectancy of the cohort has the advantage of the increase, with the result that the generation life-table expectancy comes nearer what would be found if the cohort could be followed through 85 to 100 years to obtain an actually observed average length of life (*61*). Presumably, if mortality is increasing in a country, the generation life table would show shorter life expectancies than the usual life table.

As yet, relatively few generation life tables have been made and, indeed, their construction

Figure 32. Increase in the half-century, 1901 to 1953, in the percentage of the life-table cohort of persons born alive who will still be alive at specified ages, United States death registration States.



would not be possible for a country without mortality data over a time period of some 85 years or more. Therefore the life expectancies plotted for the four countries in figure 31, after the pattern used by Sydenstricker (*62*), are from the type of life table which is usually based on mortality for periods of 1 to 10 or 15 years only.

As seen in figure 31, the slopes of the lines representing life expectancy not only increase but take a more or less sudden upward turn at some specific period. In the United States, the change occurs about 1890; in England and Wales, about 1891 to 1900; in France, in 1861–65; and in the Netherlands, about 1870–79. Even with these differences, it appears that average life expectancy took a rather abrupt upward turn at some time during the last half of the 19th century, when knowledge of better anesthetics, the beginnings of bacteriology, and better methods of sterilization were all improving the techniques of medicine and surgery, with resulting great increases in the numbers of major surgical operations.

The life expectancies of females have been consistently higher than those of males. The excesses in the life expectancy of women over men, according to these recent life tables, is least in the Netherlands, next in England and Wales, and approximately the same in the United States and in France. However, there seems to be some tendency toward an increasing excess of the life expectancy of women over men in France and the United States, and a decreasing excess in the Netherlands.

Percentage of Life Table Cohort Alive at Different Ages

Another function or column of the life table is the number (or percentage) of the hypothetical cohort of 100,000 infants born alive at a given time who would be still alive at different ages. A comparison of these percentages for life tables for different chronological periods gives a good idea of trends in mortality and life expectancy.

Figure 32 shows these percentages of the cohort of persons who would be still alive at different ages according to life tables based on the registration States of the United States in 1900–1902 (midpoint 1901), and in 1953. According to the 1953 life table, 97 percent of the liveborn infants would be still alive at the end of the first year since birth, compared with 87 percent according to the 1901 table; at 25 years, 95 percent are still alive compared with 74 percent for the 1901 table; at 50 years, 89 percent compared with 59 percent by the 1901 table, and at 85 years, 17 percent compared with 6 percent by the 1901 table. In other words, nearly three times as many persons out of the 100,000 cohort of 1953 would be expected to reach their 85th birthday according to death rates of 1953 as according to the 1901 table. If the life table had been made on a generation basis, the estimate would have been more realistic and would have shown even more persons who would be expected to survive to their 85th year of age (*65*, *66*).

Mental Diseases

Mental diseases are such a large group and require such long and extensive hospital care that it seems worth while to show trends of important specific diagnoses. New York State data are used for the psychoses (*67*).

Trends of Specific Mental and Neurological Diseases

The left half of figure 33 shows trends of 5-period moving averages of annual rates of first admissions to psychotic hospitals for each of 7 mental diseases per 1,000 total population; on the right, rates for males and females for the same seven diagnoses are shown.

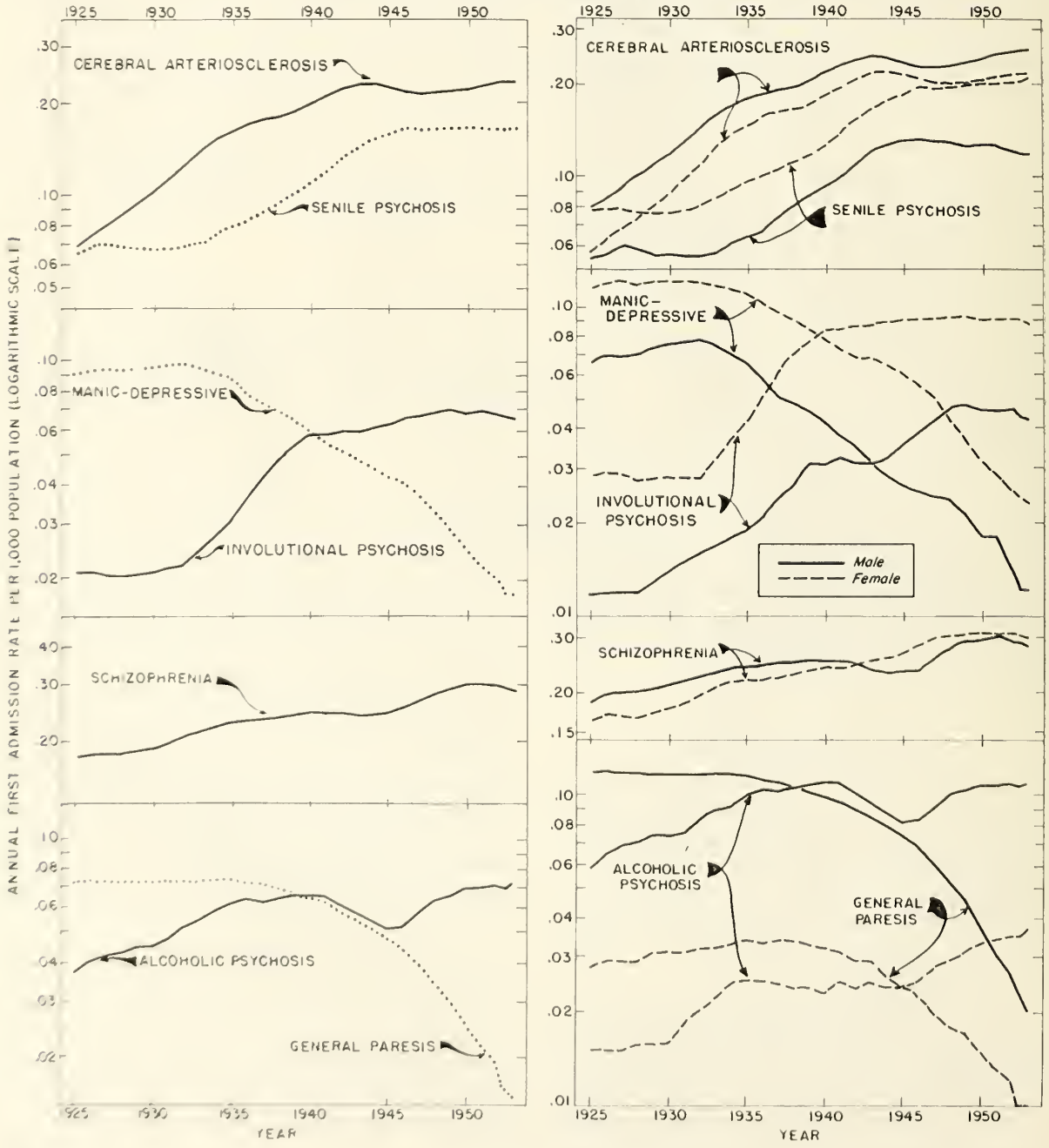
The left half of figure 33 also shows that first admission rates for 5 of the 7 diagnoses have increased considerably since 1925, but rates for 2 diseases, manic depressive psychosis and general paresis, have decreased rather sharply. Admission rates for schizophrenia are the highest but the percentage increase since 1925 has been less than that of the other four diagnoses that have been increasing.

The right half of figure 33 indicates that admission rates for senile, manic-depressive, and involutional psychoses are higher for women than for men, but cerebral arteriosclerosis, alcoholic psychosis, and general paresis have higher rates for men, the percentage excess for men over women being particularly large for

the last two types of psychoses. Schizophrenia admission rates were slightly higher for men up to the early forties, but the reverse is true for years since that time.

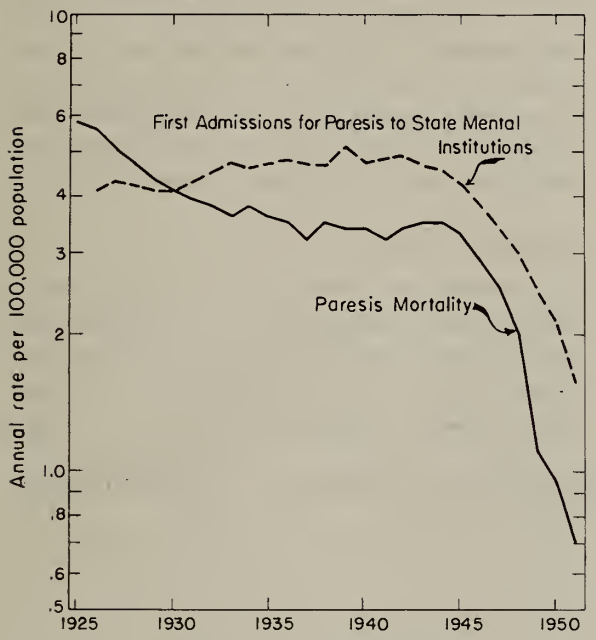
Donohue and Remein (*68*) show the death rates from paresis in the death-registration States from 1925 to 1951 and the rates of first admissions for paresis to State mental institutions in the continental United States. Figure 34 indicates that the death rate from paresis declined gradually from 5.8 per 100,000 population in 1925 to 3.5 in 1944, after which there was a sudden drop to 0.7 in 1951. First admissions for paresis to State mental institutions increased gradually from 4.1 per 100,000 population in 1926, the first year of the contin-

Figure 33. Trends of first admissions (5-period moving averages) for specific psychoses to New York State mental hospitals, by sex, 1925–55.



uous annual record, to 5.1 in 1939, but by 1942 started a rather sharp drop to 1.6 per 100,000 in 1951. During the whole period from 1926 to 1951, the percentage that paresis admissions constituted of admissions of all psychotics to State mental institutions decreased fairly consistently, from 9.5 in 1926 to 3.0 in 1951.

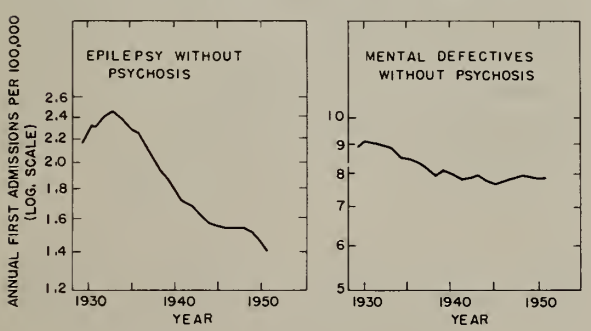
Figure 34. Trends of annual rates per 100,000 population for paresis mortality in the death registration States, and of first admissions for paresis to State mental institutions in the United States, 1926–51.



Epileptics and Mental Defectives

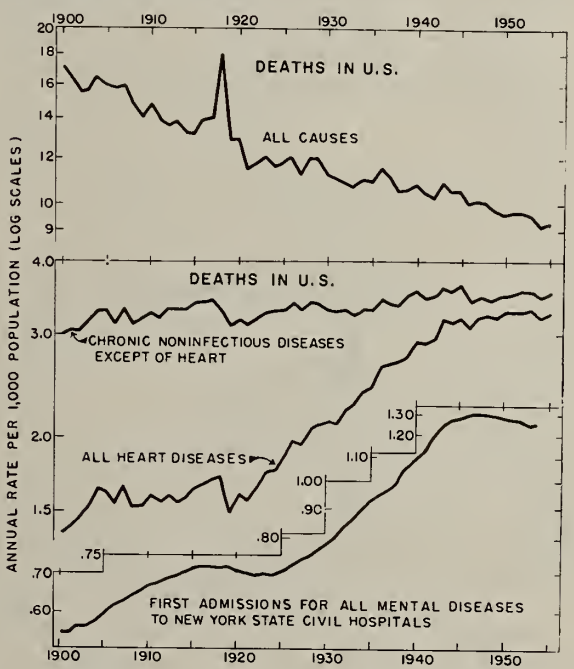
There are little or no data on the number or proportion of epileptics and mental defectives in the general population. However, data are available on the number of persons suffering from these diseases who are in institutions for the care of these diseases, and on the smaller numbers of persons who are in mental hospitals although they are not suffering from any psychosis. Trends of five-period moving averages of first admissions to such institutions and hospitals in the United States are shown in figure 35.

Figure 35. Trends of annual first admissions (5-period moving averages) of epileptics and mental defectives without psychosis to institutions for the care of those diseases and to mental hospitals, United States, 1929–51.



While there have been large fluctuations in the number of epileptics and mental defectives in these institutions, the five-period moving averages of first admissions of epileptics indicates that the numbers admitted for such care have decreased from about 2.5 to 1.4 per 100,000 population, or 44 percent, during the 18 years from 1933 to 1951. First admissions of mental defectives have decreased from 9.1 in 1930 to 7.9 per 100,000 population in 1951, or 13 percent. Some of this decrease may reflect lack of facili-

Figure 36. Trend of death rates from: (a) all causes; (b) chronic noninfectious diseases except of the heart; and (c) all heart diseases—death registration States, 1900–55; and trend of first admission rates for all mental diseases to New York State civil hospitals, 1900–53.



NOTE: See p. 45, for method of adjusting data for changes made in 1948 in the International Classification of Causes of Death.

ties for the care of more epileptics and mental defectives, but the newer therapies may have made it possible for some epileptics to live satisfactorily outside of institutions, which does not seem to be true for the type of mental defective that needs institutional care.

All Psychotics

Figure 36 shows trends of five-period moving averages of first admissions to all psychotic hospitals in New York State from 1900 to 1953, in contrast to trends of deaths from all causes, all heart diseases, and all other chronic noninfectious diseases in the expanding death-registration States.

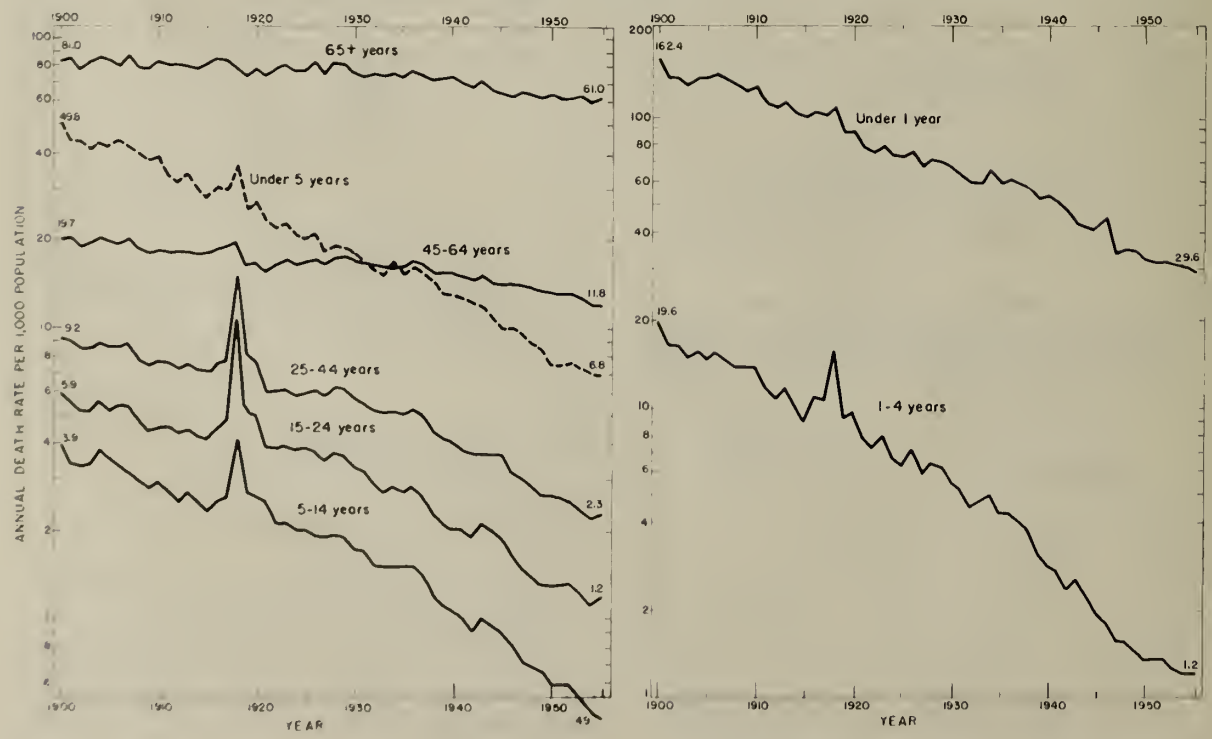
New York State reports (*67*) show first admissions from 1909 to 1953; data for 1900–1908 are estimated by computing the ratio of first to total admissions during the 10 years 1909–1918, and applying the average of the ratios to the total admissions for each year from 1900 to 1908. The ratios were quite similar throughout this period, so the average of these ratios was used to make the estimates of first admissions.

Except for a slight dip in the 1920's, the percentage increase in the rates of first admissions to hospitals for psychotics has been considerable during the half century. In contrast, death rates from all causes in the United States death-registration States have decreased gradually, except for the 1918 peak of the great influenza pandemic. However, by chance or for some unknown reason, death rates from heart diseases and first admission rates to psychotic hospitals in New York State have paralleled each other on this logarithmic vertical scale, both rates having doubled in the last half century. Noninfectious chronic diseases except of the heart have shown only a small increase, but among this group, malignant neoplasm, diabetes, and ulcer of the stomach and duodenum have shown large increases (fig. 38).

Trends of Mortality

A comparison of the trends of death rates from all causes among persons of different age groups is of interest. Figure 37 shows the trends of mortality in the United States expanding death-registration States for six age

Figure 37. Trends of annual death rates from all causes for each of eight age groups—U. S. death registration States, 1900–1955.



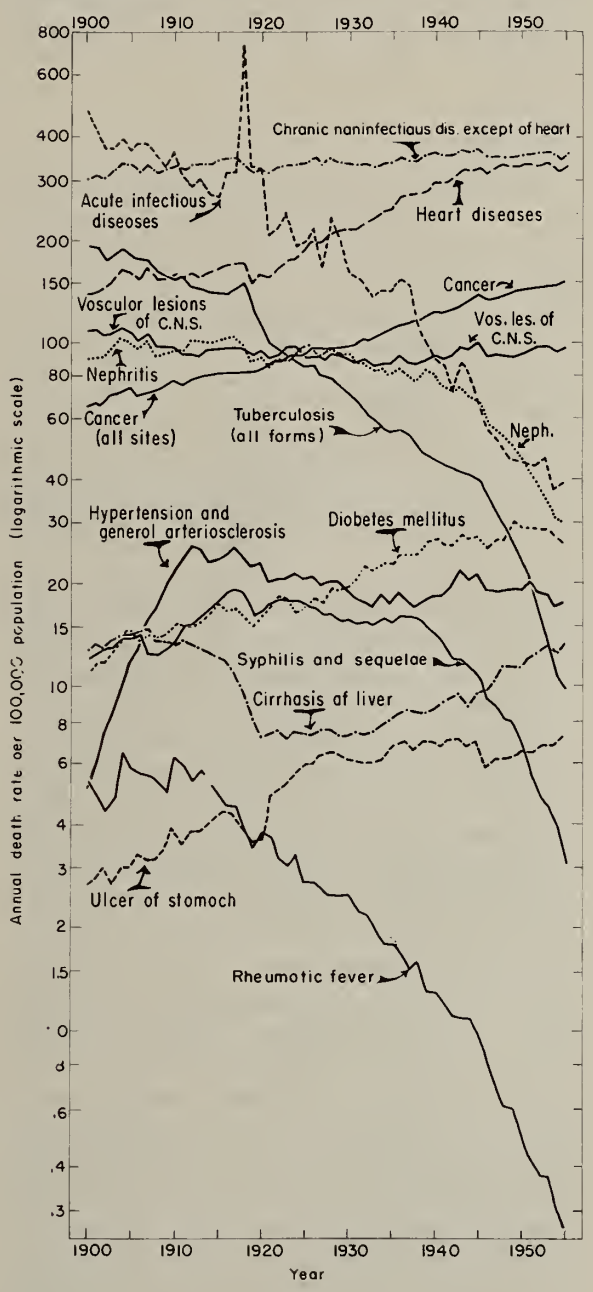
groups, with a breakdown of the youngest group (under 5 years) into under 1 year and 1–4 years of age (*69*). Since this chart has a logarithmic vertical scale, the slopes of the lines indicate the relative or percentage changes rather than actual changes in the rates. The age-group 1–4 years shows the largest percentage decrease in the 55 years since 1900, from 19.6 to 1.2 per 1,000 children of those ages, or 94 percent, compared with 82 percent for infants under 1 year of age and 86 percent for the whole group under 5 years of age.

Considering the ages above 5 years, the left half of the chart shows that the slopes of the lines which represent the percentage changes in the death rates decrease regularly as age increases, with the least decline in the mortality of the oldest age group, 65 years and over.

Figure 38 shows the trend of mortality from various important causes or groups of causes of mortality (*69*). The infectious diseases, both acute and chronic, are declining rather rapidly and, with the exception of syphilis and sequelae, have been declining for the major part of the 56 years of mortality records but with an accelerated decrease since about 1940.

It was not thought accurate or advisable to adjust all mortality rates from 1948 back to 1900 to the level of the sixth revision of the International Lists (*70*), so the rates for 1950 to 1955 were adjusted to the level of the fifth revision on the basis of a ratio obtained between the two revisions from mortality data for 1949, a sample of which was coded and tabulated by both the fifth and sixth revisions of the International Lists (*69*). This process gives the correct slope to the trends of mortality during the half century because the vertical scale is logarithmic or relative. However, the actual rates for 1950 to 1955 will not necessarily be the same as the official rates based on the sixth revision of the International Classification. Since, on a semilogarithmic chart, the relative or percentage slope of a given line is the same whether the rates are large or small, the conversion was done graphically.

Figure 38. Trends of death rates from important specific causes, U. S. death registration States, 1900–1955.



Mortality and Illness in Urban and Rural Areas

In the first three decades of the 20th century there was much discussion and writing about death rates in urban areas compared with rural areas, especially death rates from tuberculosis.

Mortality

As most of the tuberculosis sanatoriums were and still are located outside the cities, and as there were at that time few vital statistics offices in the United States which allocated deaths to the place of residence of the decedent, many tuberculosis patients who lived in cities died in sanatoriums in rural areas and were counted as deaths of rural people. Studies based on New York State deaths from tuberculosis were made by Sydenstricker (*71*), DePorte (*72*), and Whitney (*73*), with special reference to the risk of tuberculosis in urban areas compared with the risk in rural areas. Although the methods were different, these and other authors agreed that age-adjusted, residence-corrected death rates from tuberculosis were higher in urban than in rural areas.

Parkhurst (*74*) also studied mortality from tuberculosis (all forms) by age and sex in New York City, in other urban places in New York State, and in rural parts of New York State in the years 1929–31. Among females, the age curves of mortality rates from tuberculosis were quite similar in New York City, in other urban areas, and in rural areas, and the age curve for rural males was not greatly different from that for rural females. However, the age curve of tuberculosis mortality for New York City males was quite different, rising from 10 per 100,000 population at 10–14 years of age to 199 at 55–64 years and to 164 at 65–74, but with a drop to 116 at 75 and over. The curve for urban males outside of New York City was intermediate between those for New York City and for rural males but more like the New York City curve than the curve for rural males.

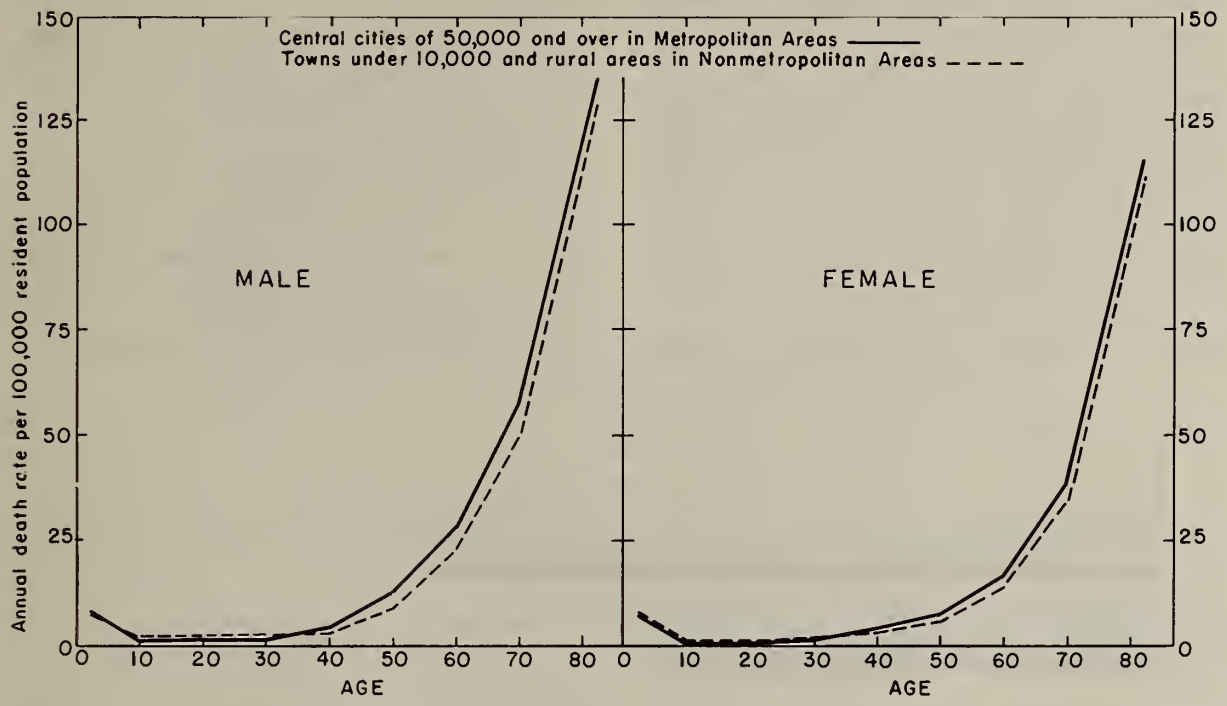
Further data in the same study for New York State exclusive of New York City indicate that the extremely high tuberculosis death rates for males were due largely to the foreign-born and the native-born of foreign parents; rates for native white males of native parents were not greatly above those for females, but 15–34 year old native white females of foreign-born parents had considerably higher rates than younger or older females of that racial category.

In another study, Parkhurst (*75*) shows for the 3-year period 1949–51 average annual mortality rates from all causes, adjusted for age and corrected for residence, with similar rates by age and sex, for two groups of places: those with populations of less than 10,000 and rural areas; and central cities of 50,000 and over in metropolitan areas of New York State (fig. 39).

The age curves of death rates from all causes among males living in cities and towns of the two different sizes lie close together, but, except for the age groups 5–34 years for males and under 35 years for females, the age-specific death rates as well as the age-adjusted rates for all ages are consistently higher in the central cities of 50,000 and over in metropolitan areas than in places under 10,000 and in rural areas in nonmetropolitan districts. Death rates among persons 35 years of age and older are slightly but consistently higher in cities of 50,000 or over in metropolitan areas. The same may be said of death rates of females except that the excesses of urban rates over rural rates for persons over 35 years of age are slightly smaller than among males.

The same study shows annual age-adjusted and residence-corrected death rates from heart disease, tuberculosis, pneumonia, diabetes, cirrhosis of the liver, nephritis, and accidents and suicide in 1949–51 (fig. 40). All these diseases, except nephritis, have higher rates in central cities of 50,000 or more population in metropolitan areas than in cities of 10,000 to 50,000 population in metropolitan and nonmetropolitan areas and in cities of less than 10,000 population and rural areas in the same two types of areas. The rates for the two groups of smaller cities are simple averages of

Figure 39. Annual age-sex specific death rates from all causes among residents of cities of 50,000 and over in metropolitan areas as compared with residents of towns under 10,000 and rural parts of nonmetropolitan areas in New York State exclusive of New York City, 1949–51 (*75*).



rates for the given cause in cities of the given size in metropolitan and nonmetropolitan areas. However, the two accident categories and suicide show a regular progression but this progression is from low rates in the large cities to higher rates in the smaller cities and rural areas.

Dorn (*76*) shows mortality rates, by sex, for urban and rural areas in New York State and for the native white population living in communities of different sizes in Ohio in 1930. The Ohio data are exclusive of deaths in institutions and the rates are all standardized for age and corrected for residence. Comparison is made between rural and urban death rates, with the urban rates divided into those for cities of 100,000 and over, 10,000 to 100,000, and 2,500 to 10,000. For males and also for females, the Ohio rates were slightly lower in rural areas (8.7 for males and 8.3 for females) than in urban places combined (10.4 and 8.6, respectively). Standardized rates for males living in cities of 100,000 and over, 10,000 to 100,000, and 2,500 to 10,000 were 23, 18, and 15 percent, respectively, in excess of those for males living in rural areas. Corresponding ratios for females living in cities of similar sizes were only 5, 2, and 1 percent, respectively, in excess of those for females living in rural areas.

Dorn also shows annual death rates from all causes for the period 1929–31 for rural areas of New York State compared with urban places, subdivided into six groups of cities of different sizes, from 250,000 and over to 2,500–10,000 population. Considering all urban places together, the annual death rate, standardized for age, was 11.4 per 1,000 population, compared with 11.0 in rural places, or about 4 percent greater in the urban area. The other population sizes of cities with annual death rates 3 percent or more above corresponding rates for rural areas were: 250,000 and over, annual rate of 12.7 per 1,000, or 15 percent above; 10,000–25,000, 11.3 per 1,000 population, or 3 percent above; and 2,500–10,000 population, 11.9 per 1,000, or 8 percent above the rural.

Illness Data From Household Surveys

In a study of illness obtained by household surveys in 18 States, Dorn (*76*) shows rates among residents of rural open country and of

villages and cities of three sizes. Case rates, standardized for age for all causes of illness, are shown by sex for each of these four types of areas for all cases recorded in the survey and for cases that were disabling in the sense that they kept the patient from usual activities for 1 day or longer, whether work away from home, housework, school, or other usual activities. In this study, case rates of illness were somewhat higher in towns under 5,000 in population and in those of 5,000 to 100,000 than in rural open country or in cities of 100,000 or more population. This was true of all recorded cases and also of cases that disabled for 1 day or longer.

In simultaneous surveys (*12*, *13*) of illness in three types of places—Cattaraugus County, N. Y., open country and villages ranging up to 900 population, and the city of Syracuse, N. Y.—the same schedule and methods were used, with some interchange of field interviewers between areas of the three types. Figure 41 shows the data for respiratory and total cases classified as nondisabling, disabling for 1 day

Figure 40. Annual death rates from 10 rather specific causes in large cities, small cities, and towns and rural areas in New York State, exclusive of New York City, 1949–51 (*75*).

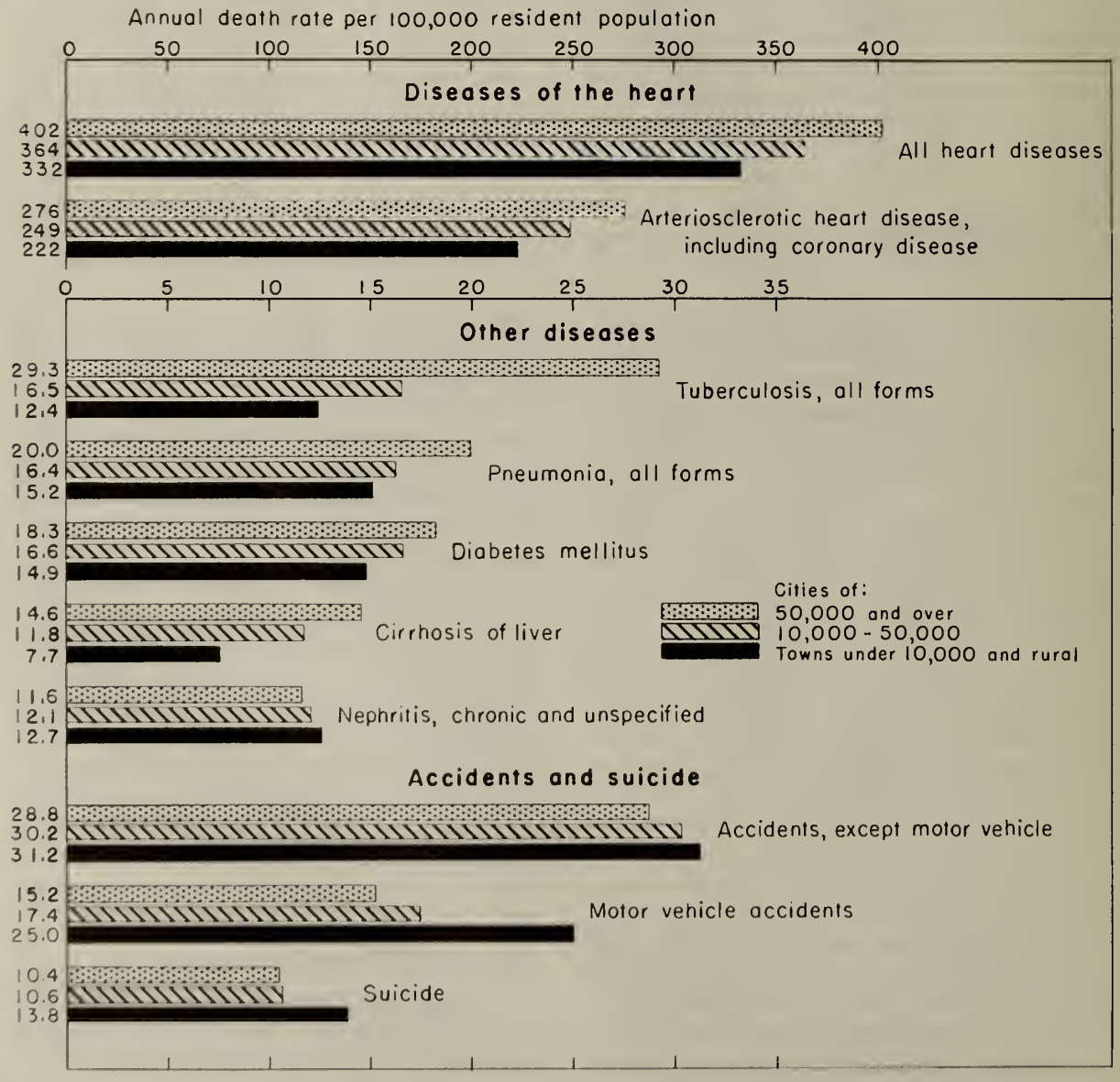
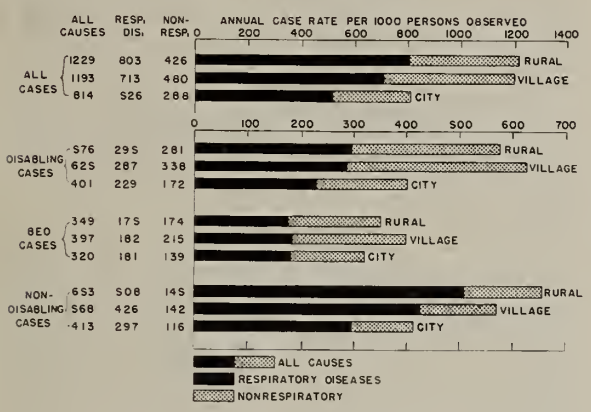


Figure 41. Annual case rates of all illness and of respiratory diseases as found among farm residents and small villages in Cattaraugus County, N. Y., and in the city of Syracuse, N. Y., 1929–32.



or longer, with cases confined to bed for 1 day or longer as a subgroup of disabling cases.

Annual illness rates for all causes per 1,000 population were slightly higher in the open country, varying from 1,229 there to 1,193 in the villages and 814 in Syracuse, with respiratory cases varying from 803 per 1,000 population to 713, and 526, in the same three types of areas, respectively. Variation in disabling respiratory cases followed the same pattern but was less than that in total cases; disabling nonrespiratory cases were more frequent in the villages than in the open country, but the differences were relatively small. Respiratory cases confined to bed for 1 day or longer varied only from 175 to 182 per 1,000 population, with the villages having slightly higher rates for total and for both respiratory and nonrespiratory bed cases. Nondisabling case rates showed the greatest variability from one type of area to another in total case rates and also in respiratory case rates, with rural open country having the highest rates and Syracuse the lowest. Thus, the data in figure 41 indicate the greatest variability in the mildest type of cases, which are most likely to be forgotten by the family informant, with practically no variation in bed cases, which are least likely to be forgotten.

Little information is available to deny or corroborate the finding of less illness in cities than in rural areas; however, it would appear that in a comparison in which the months between the interview when the illness record was obtained and the months for which illness was obtained are held constant, one would have the most accurate comparison of urban-rural illness rates.

Case rates for nearly every illness category and for nearly every month are lower for Syracuse than for the open country and the villages in Cattaraugus County (fig. 42). However, this finding must be viewed with some skepti-

Figure 42. For three types of areas (open country, village, and city) recorded case frequency of illness of different severities with constant intervals between the time of the family interview and the period for which illness was recorded.

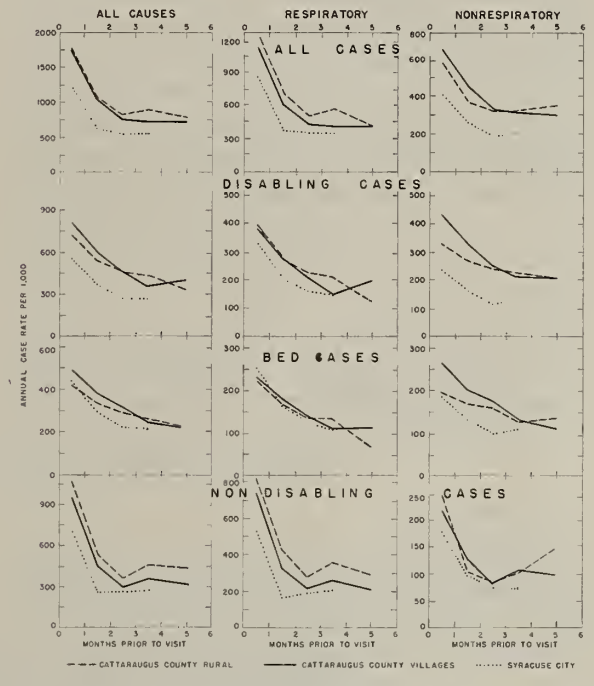


Figure 43. Annual first admission rates, standardized for age, for all psychoses of residents of cities and towns of four sizes to New York State civil hospitals, 1929–31.

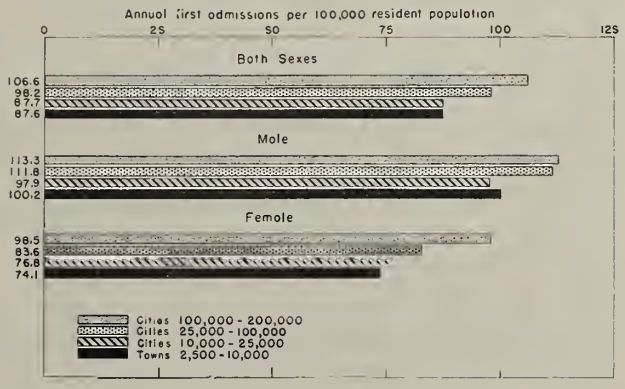
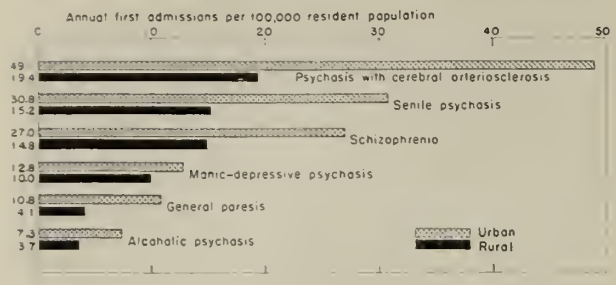


Figure 44. Annual first admission rates for six specific psychoses to New York State civil hospitals for all ages of both sexes, corrected for residence and standardized for age, urban and rural parts of New York State, 1929–31.



cism since interviewers in rural areas, where fewer agents and salesmen come to the houses, reported that they were received more cordially than they were in Syracuse. Because of the more cooperative attitude of the informants, the reports to interviewers in rural areas may have been more complete than the reports to interviewers in Syracuse. The fact that the only large and consistent differences between urban and rural illness rates occur in the nondisabling category, in which the memory factor is the greatest handicap, also suggests caution in accepting the findings as to these urban and rural illness rates.

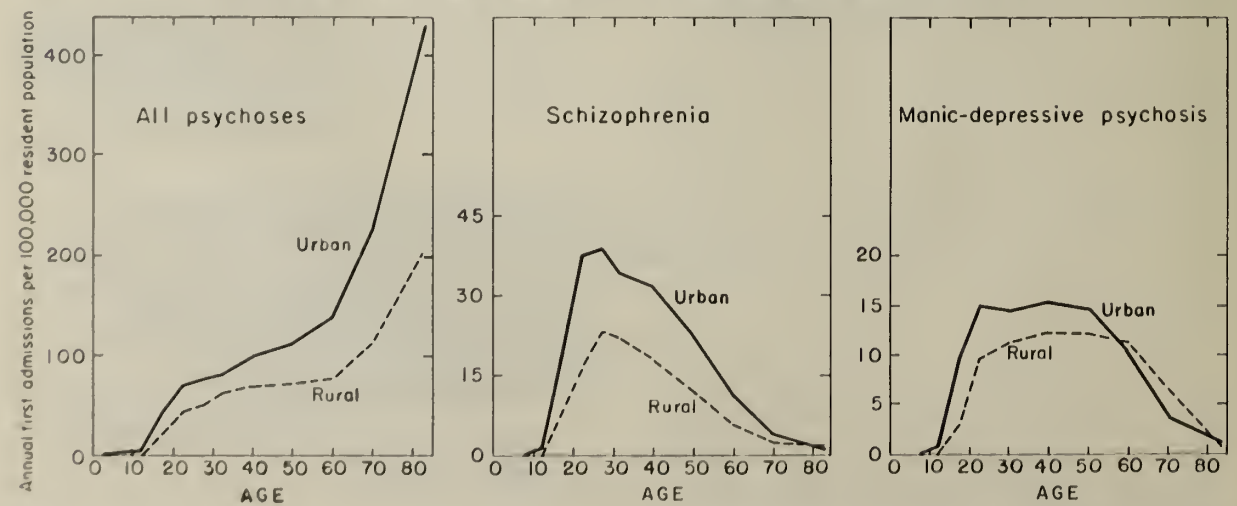
Mental Illness

Malzberg (*77*) shows data on average annual first admissions for all mental diseases to New York State civil hospitals during the 3-year period ending June 30, 1931. For both sexes combined, first admission rates for all psychoses, corrected for residence and standardized for age, for the 4 groups of towns and cities (excluding New York City) with populations of 2,500 to 200,000 ranged from 88 per 100,000 population in the two groups of cities of 2,500–25,000 to 107 in cities of 100,000–200,000 population (fig. 43).

For males, the first admission rates for all psychoses, corrected for residence and standardized for age, for the 4 groups of towns and cities (excluding New York City) with populations of 2,500 to 200,000 ranged from 98 per 100,000 population in cities of 10,000–25,000 to 113 in cities of 100,000–200,000 population (fig. 43). The towns of 2,500–10,000 population had only a slightly higher rate (100 per 100,000) than the lowest rate of 98 per 100,000, but otherwise the rates increased slightly but regularly with size of city.

None of the rates for all psychoses for females in the four city-size groups was above 100. First admission rates for all psychoses for females increase gradually but regularly from 74 in towns of 2,500 to 10,000 population to 98 in cities of 100,000 to 200,000. Rates in three of the four city sizes are less than in any city-size category for males, and rates for all four city-size categories for females are considerably less than corresponding city-size categories for males.

Figure 45. Annual age-specific first admission rates of residents of urban and rural places to New York State civil hospitals for all psychoses and for two specific psychoses, 1929–31.



Malzberg shows also that the annual first admission rate for all psychoses for males from all urban places (adjusted to New York State population 15 years old and over) was 114 per 100,000 population compared with 65 for all rural areas. The corresponding first admission rates for females from all urban and all rural places were 90 and 58 per 100,000, respectively.

First admission rates for all ages of both sexes, corrected for residence and standardized for age, are shown in figure 44 for six specific psychoses for urban and rural parts of New York State. The first admission rates to mental hospitals for 5 of the 6 psychoses were approximately twice or more than twice as high for urban places as for rural areas. The only real exception was manic-depressive psychosis but schizophrenia was just under twice as high. The admission rate for manic-depressive psychosis was also higher for urban places but was much less than twice the rural rate.

Malzberg also shows, by age, first admissions for all psychoses and for two specific psychoses from urban and rural areas for the 3 years ending June 30, 1931. Figure 45 shows these data in graphic form. The rates for all psychoses (left box), corrected for residence, are consistently higher for admissions from urban places, and the excess of urban over rural rates increases with age, until at 75 years and over the urban first admission rates are more than twice as high as the rural rates.

Schizophrenia rates are consistently higher for urban residents at every age from 10 through 74 years, with the peak rates in both urban and rural groups at 25–29 years of age, when the urban rate is 71 percent higher than the rural rate.

Manic-depressive psychosis admission rates are consistently higher for urban residents 10–54 years of age and 75 years and over, but from 55–74 years the reverse is true.

Trend and Age Variation of Mortality and Morbidity From Influenza and Pneumonia

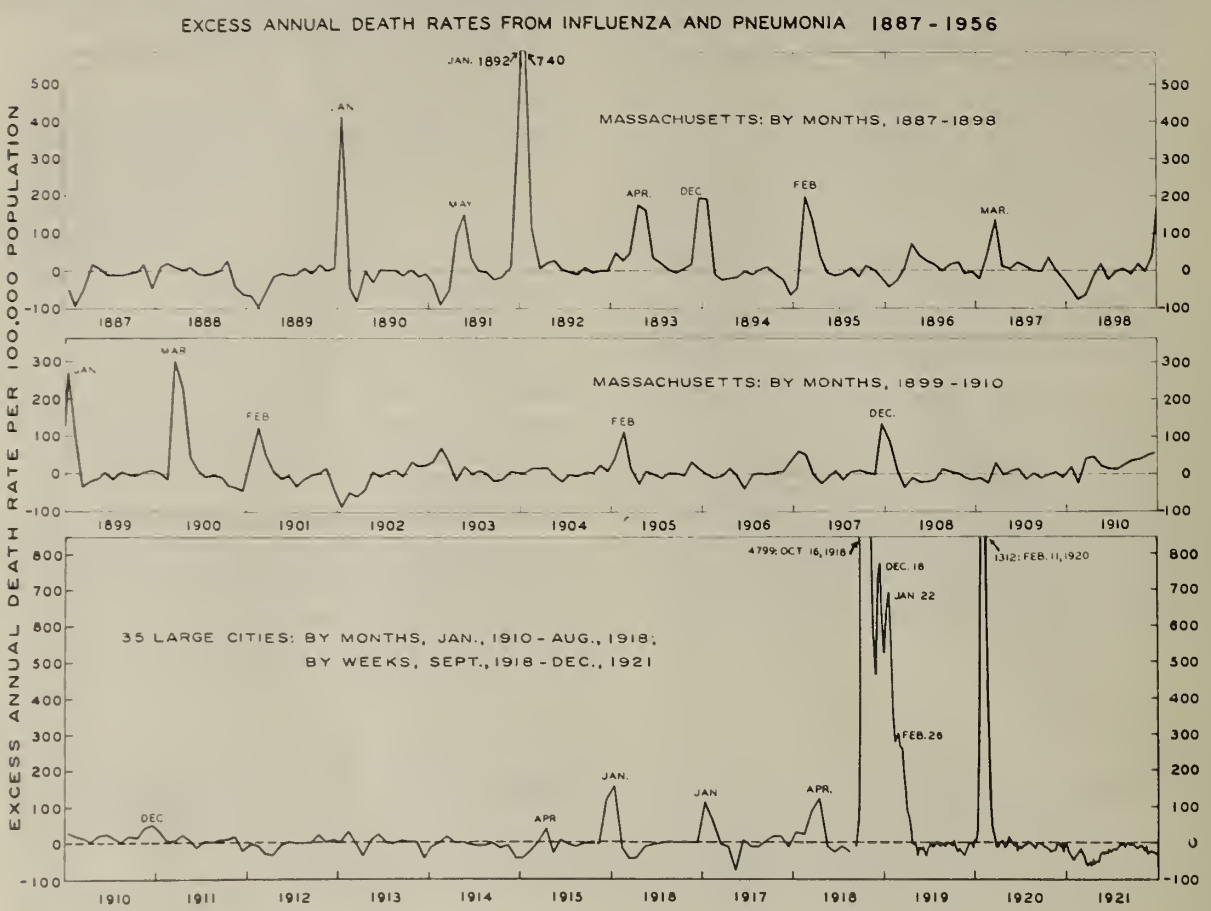
Influenza and its frequent complication, pneumonia, and the excessively high death rates all over the world during the great influenza pandemic of 1918–19 have given rise to much clinical, laboratory, and statistical research. Rather frequent epidemics of moderate severity occurred in the last quarter of the 19th and the first half of the 20th centuries, but nothing within modern times has approached the 1918–19 pandemic, with its estimated 550,000 deaths in excess of the usual expectancy in the United States in those years (*78*) and a total of 21,642,000 deaths credited to influenza and pneumonia throughout the world in the three waves of that epidemic.

In Jordan's Epidemic Influenza (*79*) estimates of deaths from influenza-pneumonia are given by country and summarized by continent (pp. 228–229) as follows: North America, 1,075,685; South America, 327,250; Europe, 2,163,303; Asia, 15,757,363; Australia and Oceania, 965,254; Africa and Madagascar, 1,353,428; total, 21,642,283.

E. Symes Thompson (*80*), in a study of influenza epidemics in Great Britain from 1510 to 1890, traces the major epidemics that occurred during that 380-year period and discusses some 20 of them. Included in this list is an epidemic in 1173. These epidemics all appear to be due to influenza and have been so described in earlier writings, but they differ markedly. Many originated on the Continent and others spread from England to Europe and Asia.

In studies of influenza, the statistical measure most commonly used of the extent of an epidemic is the death rate from influenza and pneumonia in excess of the usual seasonal ex-

Figure 46. Excess annual death rates from influenza and pneumonia in the populations of various States and groups of cities in the United States, 1887–1956.



pectancy, with account taken of trend also. This expectancy is measured in different ways but always to represent a base expectancy, usually in weekly rates (annual basis) exclusive of epidemic increases. Such a norm or average for the different weeks of a year may be based on a median of rates for each of the 52 weeks over a reasonable period of years, or for a long series of years if there is no trend in the rates or if correction is made for trends not associated with epidemics.

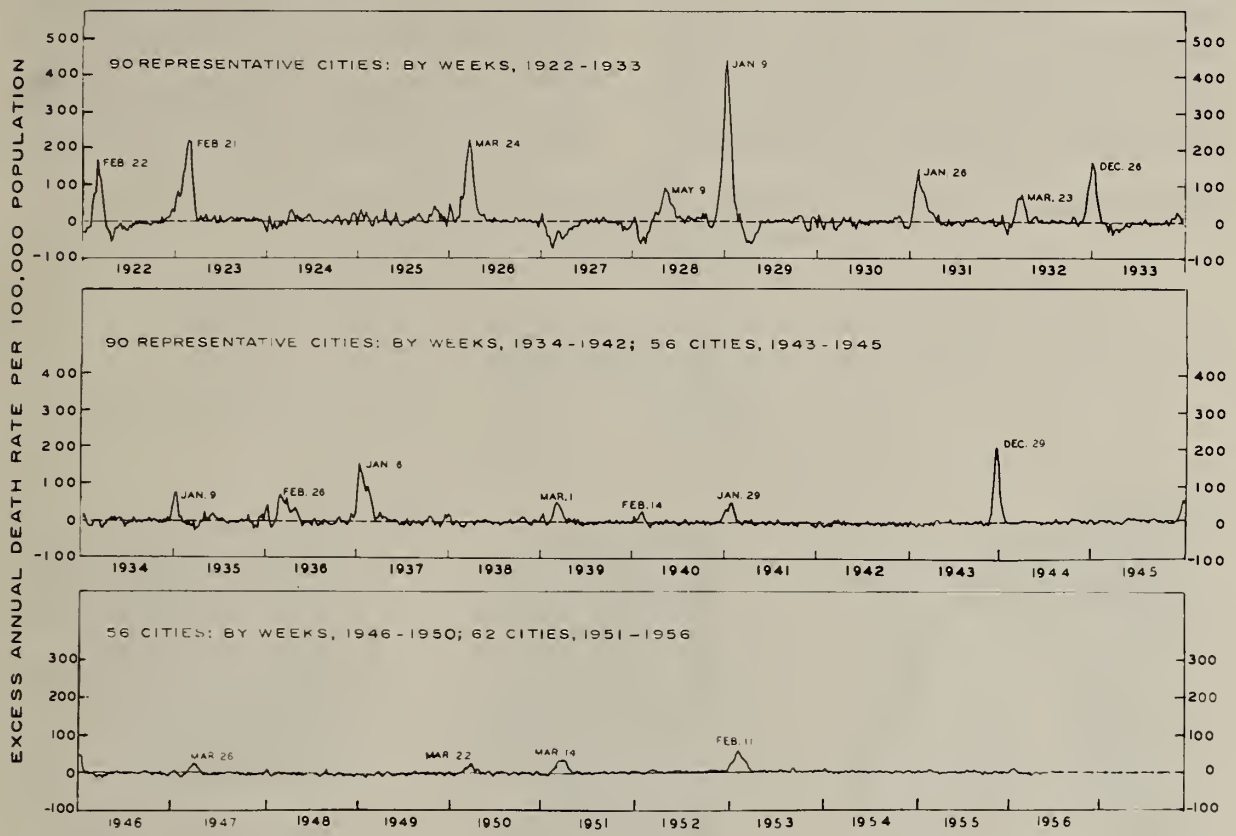
Trend

Influenza epidemics spread so rapidly and last such a short time in a given community that weekly death rates are essential to give a realistic picture of the true excess mortality that occurs during a given epidemic, the true duration of the epidemic, and other characteristics of the disease. However, in the United States, deaths from influenza and pneumonia were not generally tabulated by weeks prior to September 1918, when the great pandemic began; therefore, excess deaths in epidemics before that time can be measured by monthly data only.

The earliest records now available for any State in the United States are deaths by months from influenza and pneumonia in Massachusetts. These monthly excess death rates (annual basis) are shown in the two top sections of figure 46 for the years 1887 to 1910, inclusive, during which time 12 small and moderate-sized outbreaks occurred; the larger ones include those with peaks in January 1890, December–January 1891–92, January 1899, and March 1900 (*81*, *83*).

Figure 46 also shows influenza and pneumonia excess death rates, by months, in a group of 35 large cities in the United States from Jan-

Figure 46. Excess annual death rates from influenza and pneumonia in the populations of various States and groups of cities in the United States, 1887–1956.—Continued



uary 1910 through August 1918, during which period 3 epidemics occurred with peaks in January 1916, January 1917, and April 1918. Beginning with September 1918, data for the same group of 35 cities are shown by weeks to the end of 1921. Starting with January 1922 (fig. 46), the record is continued by weeks for a group of 90 representative cities to the end of 1942, after which time the data are shown by weeks for a group of 56 large cities to the end of 1950, at which time 6 cities were added to make 62 cities carried until early in 1956 (*82*).

Figure 46 shows the high fall peak of the great pandemic, which occurred in October 1918 and was followed by two smaller secondary peaks in December 1918 and January 1919 respectively. These latter peaks are higher than any peak of influenza mortality that has occurred since that time, except the peak of 1920.

During the 70 years represented in figure 46, 1887 to 1956, inclusive, there were 41 epidemics. These ranged in size from three which showed excess deaths in only a few geographic sections, with no measurable excess for the total of all sections of the United States, to the pandemic of 1918–19, which was excessively severe in all sections but less severe in some than in others. Table 7 summarizes these epidemics with respect to total actual excess death rates from influenza and pneumonia, date of middle of the peak week, and number and dates of the weeks that were found to be above the normal expectancy of influenza-pneumonia death rates.

Figure 46 for Massachusetts and the several groups of cities in the United States shows only the excess deaths credited solely or primarily to influenza and pneumonia. But, contrary to first expectations, it was found that peaks of excess influenza-pneumonia mortality were accompanied by small peaks of deaths credited to causes other than influenza and pneumonia. The first task was to find the extent of these peaks of deaths not credited to influenza or pneumonia which, nevertheless,

occurred at approximately the same time as the deaths in the influenza epidemics. This process consisted of treating the weekly death rates from all causes for the same groups of cities in approximately the same way as those from influenza and pneumonia, to obtain death rates from all causes in excess of normal expectancy.

As data on deaths from all causes were not available for all of the 90-city group in figure 46 the data for the 35 large cities included in that figure were continued from 1921 to the end of 1934, and data for the group of 56 large cities were used for the period 1935 to 1950, with the addition of 6 cities from 1951 to the

Table 7. Summary of epidemics of influenza and pneumonia in Massachusetts and in groups of cities in the United States, 1887–1956

Date of epidemic and sections with highest and lowest total excess	Actual excess rate per 100,000 during whole epidemic	Wednesday of peak week or month of peak	Total period considered as above normal	
			Number of—	Months or weeks included
Massachusetts:			*Months*	
Early 1890	34.8	January 1890	1	January 1890.
Spring 1891	23.9	May 1891	3	April–June 1891.
1891–92	98.5	January 1892	3	December 1891–February 1892.
Spring 1893	35.5	April 1893	4	March–June 1893.
1893–94	33.0	December 1893	2	December 1893–January 1894.
Early 1895	31.0	February 1895	3	February–April 1895.
Spring 1897	15.4	March 1897	2	February–March 1897.
1898–99	34.7	January 1899	3	December 1898–February 1899.
Spring 1900	47.8	March 1900	3	March–May 1900.
Early 1901	17.1	February 1901	3	January–March 1901.
Early 1905	13.8	February 1905	3	January–March 1905.
1907–08	19.7	December 1907	3	December 1907–February 1908
Spring 1915	12.6	April 1915	2	March–April 1915.
35 large cities:				
1915–16	22.8	January 1916	2	December 1915–January 1916.
Early 1917	14.0	January 1917	2	January–February 1917.
Spring 1918	21.1	April 1918	4	January–April 1918.
			Weeks	
1918–19	550.5	Oct. 16, 1918	31	Sept. 15, 1918–Apr. 19, 1919.
90 representative cities:				
Early 1920	99.3	Feb. 11, 1920	12	Jan. 4–Mar. 27, 1920.
High: Mountain	159.5	Feb. 11, 1920	14	Jan. 4–Apr. 10, 1920.
Low: Pacific	57.7	Feb. 11, 1920	11	Jan. 18–Apr. 3, 1920.
Early 1922	18.3	Feb. 22, 1922	12	Jan. 8–Apr. 1, 1922.
High: Pacific	36.3	Feb. 22, 1922	9	Jan. 29–Apr. 1, 1922.
Low: South Atlantic	9.4	Mar. 29, 1922	8	Feb. 19–Apr. 15, 1922.
1922–23	29.9	Feb. 21, 1923	17	Nov. 26, 1922–Mar. 24, 1923.
High: West North Central	53.3	Feb. 28, 1923	18	Nov. 26, 1922–Mar. 31, 1923.
Low: West South Central	6.7	Feb. 28, 1923	10	Jan. 14–Mar. 24, 1923.
1925–26	25.3	Mar. 24, 1926	17	Jan. 31–May 29, 1926.
High: West South Central	58.8	Feb. 10, 1926	20	Nov. 8, 1925–Mar. 27, 1926.
Low: Pacific	9.3	Jan. 6, 1926	9	Dec. 27, 1925–Feb. 27, 1926.
Spring 1928	11.6	May 9, 1928	19	Mar. 11–July 21, 1928.
High: Middle Atlantic	20.9	May 9, 1928	19	Mar. 11–July 21, 1928.
Low: West North Central	1.9	May 2, 1928	10	Apr. 8–June 16, 1928.
Winter 1928–29	44.4	Jan. 9, 1929	12	Nov. 25, 1928–Feb. 16, 1929.
High: East South Central	92.0	Jan. 9, 1929	9	Dec. 2, 1928–Feb. 2, 1929.
Low: New England	12.3	Jan. 23, 1929	9	Dec. 30, 1928–Mar. 2, 1929.
Winter 1930–31	16.4	Jan. 28, 1931	16	Dec. 28, 1930–Apr. 18, 1931.
High: South Atlantic	27.2	Feb. 11, 1931	16	Dec. 28, 1930–Apr. 18, 1931.
Low: East North Central	9.7	Feb. 25, 1931	10	Jan. 11–Mar. 21, 1931.
Early 1932	7.4	Mar. 23, 1932	9	Feb. 14–Apr. 16, 1932.
High: Mountain	24.1	Jan. 6, 1932	17	Dec. 13, 1931–Apr. 9, 1932.
Low: East North Central	4.6	Mar. 2, 1932	7	Feb. 14–Apr. 2, 1932.
Winter 1932–33	19.2	Dec. 28, 1932	11	Nov. 20, 1932–Feb. 4, 1933.
High: West North Central	12.7	Dec. 28, 1932	15	Nov. 20, 1932–Mar. 4, 1933.
Low: East North Central	13.8	Dec. 28, 1932	12	Nov. 6, 1932–Jan. 28, 1933.
Winter 1934–35	5.4	Jan. 9, 1935	9	Dec. 2, 1934–Feb. 2, 1935.
High: East South Central	28.3	Jan. 9, 1935	17	Nov. 25, 1934–Mar. 23, 1935.
Low: Middle Atlantic	5.3	Jan. 2, 1935	9	Nov. 18, 1934–Jan. 19, 1935.

middle of 1956. Of the 6 cities added, all were in the Mountain States and 5 were under 100,000 in population, but the Mountain States were poorly represented and additional cities were badly needed for the study. The weekly excess death rates from influenza and pneumonia were then subtracted from the excess death rates from all causes for the same weeks to obtain weekly excess death rates from causes credited primarily to diseases other than influenza and pneumonia which occurred during influenza epidemics, usually with peaks in the same week as the influenza peak.

It would, of course, have been better to have

Table 7. Summary of epidemics of influenza and pneumonia in Massachusetts and in groups of cities in the United States, 1887–1956—Continued

Date of epidemic and sections with highest and lowest total excess	Actual excess rate per 100,000 during whole epidemic	Wednesday of peak week or month of peak	Total period considered as above normal	
			Number of—	Months or weeks included
90 representative cities—Continued			*Weeks*	
Winter 1935–36	12.5	Feb. 26, 1936	22	Dec. 22, 1935–May 23, 1936.
High: East South Central	61.1	Mar. 25, 1936	24	Dec. 1, 1935–May 16, 1936.
Low: Pacific	4.5	Mar. 4, 1936	6	Feb. 9–Mar. 21, 1936.
Winter 1936–37	18.4	Jan. 6, 1937	11	Dec. 20, 1936–Mar. 6, 1937.
High: Mountain	68.0	Jan. 20, 1937	11	Dec. 13, 1936–Feb. 27, 1937.
Low: Middle Atlantic	11.4	Jan. 6, 1937	7	Dec. 27, 1936–Feb. 13, 1937.
Early 1939	5.2	Mar. 1, 1939	9	Feb. 5–Apr. 8, 1939.
High: East North Central	11.8	Mar. 1, 1939	7	Feb. 12–Apr. 1, 1939.
Low: Middle Atlantic	2.9	Feb. 8, 1939	7	Jan. 22–Mar. 11, 1939.
Early 1940	1.9	Feb. 14, 1940	6	Jan. 21–Mar. 2, 1940.
High: West South Central	13.5	Feb. 7, 1940	8	Jan. 21–Mar. 16, 1940.
Low: South Atlantic	5.8	Jan. 31, 1940	5	Jan. 21–Feb. 24, 1940.
Winter 1940–41	5.4	Jan. 29, 1941	10	Dec. 15, 1940–Feb. 22, 1941.
High: Mountain	15.6	Jan. 8, 1941	6	Dec. 22, 1940–Feb. 1, 1941.
Low: East North Central	1.9	Jan. 29, 1941	4	Jan. 19–Feb. 15, 1941.
56 cities:				
Winter 1942–43 [1]				
High: East and West South Central	9.1	Jan. 13, 1943	16	Dec. 20, 1942–Apr. 10, 1943.
Low: New England	5.4	Apr. 14, 1943	8	Mar. 21–May 15, 1943.
Winter 1943–44	14.4	Dec. 29, 1943	11	Nov. 28, 1943–Feb. 12, 1944.
High: East and West South Central	25.7	Dec. 29, 1943	15	Nov. 28, 1943–Mar. 11, 1944.
Low: Pacific	9.8	Jan. 5, 1944	11	Dec. 5, 1943–Feb. 19, 1944.
Winter 1945–46	3.7	Dec. 26, 1945	11	Nov. 25, 1945–Feb. 9, 1946.
High: Mountain	16.9	Feb. 20, 1946	13	Dec. 2, 1945–Mar. 2, 1946.
Low: Pacific	2.9	Dec. 26, 1945	12	Dec. 23, 1945–Mar. 16, 1946.
Early 1947	2.5	Mar. 26, 1947	11	Feb. 16–May 3, 1947.
High: West North Central	9.3	Mar. 12, 1947	12	Feb. 16–May 10, 1947.
Low: South Atlantic	2.6	Apr. 2, 1947	8	Mar. 9–May 3, 1947.
Winter 1947–48 [1]				
High: East and West South Central	6.5	Feb. 25, 1948	12	Dec. 28, 1947–Mar. 20, 1948.
Low: Pacific	4.1	Jan. 14, 1948	14	Dec. 14, 1947–Mar. 20, 1948.
Winter 1948–49 [1]				
High: East and West South Central	2.9	Feb. 2, 1949	8	Dec. 26, 1948–Feb. 19, 1949.
Low: Mountain	2.6	Mar. 16, 1949	8	Mar. 13–May 7, 1949.
Early 1950	2.7	Mar. 22, 1950	9	Feb. 26–Apr. 29, 1950.
High: West North Central	3.3	Mar. 29, 1950	8	Feb. 19–Apr. 15, 1950.
East and West South Central	3.3	Mar. 29, 1950	11	Feb. 19–May 6, 1950.
Low: Middle Atlantic	3.2	Mar. 22, 1950	9	Feb. 26–Apr. 29, 1950.
South Atlantic	3.2	Mar. 29, 1950	11	Feb. 12–Apr. 29, 1950.
Mountain	3.2	Feb. 22, 1950	6	Feb. 19–Apr. 1, 1950.
62 cities:				
Early 1951	3.8	Mar. 14, 1951	10	Feb. 11–Apr. 21, 1951.
High: New England	6.5	Feb. 28, 1951	8	Feb. 11–Apr. 7, 1951.
Low: East North Central	3.1	Mar. 21, 1951	11	Mar. 4–May 19, 1951.
Early 1953	6.9	Feb. 11, 1953	13	Dec. 28, 1952–Mar. 28, 1953.
High: Mountain	13.0	Jan. 28, 1953	14	Dec. 14, 1952–Apr. 21, 1953.
Low: East North Central	3.4	Feb. 11, 1953	11	Dec. 28, 1952–Mar. 14, 1953.

[1] No measurable excess in the group of cities as a whole, but excesses in some geographic sections.

had a record of influenza-pneumonia epidemics for the same population group for the whole 70 years included in figure 46. However methods of recordkeeping and disease classification are not infrequently changed, so for such a study as the present one, one has to compromise and put together such trend data as are available.

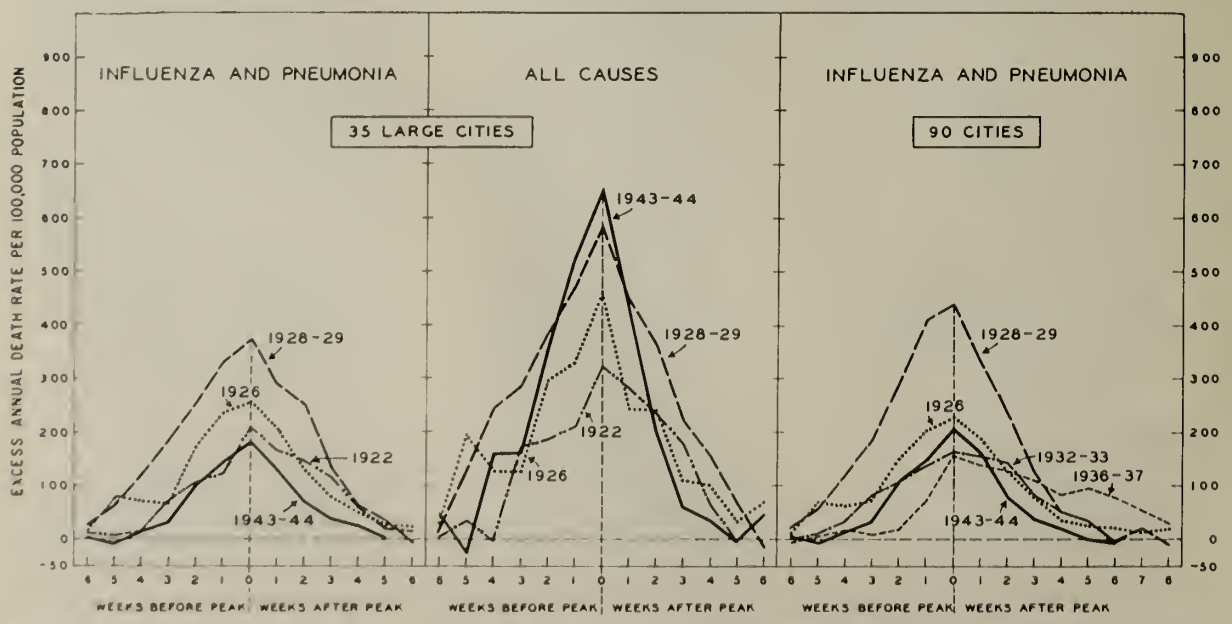
The two end boxes of figure 47 show the maximum heights of the excess rates from influenza and pneumonia in several of the same epidemics, and the variation in the time that the rates exceeded the usual expectancy. The peak week of each epidemic is plotted in the center, with the weeks before the peak on the left and the weeks after the peak on the right. Comparison of the excess curves for the same epidemic in the two end boxes of figure 47 shows that the curves of excess rates are similar, whether they are based on the 90 cities (right box) or the 35 large cities (left box). Although some of this similarity comes from the fact that many of the same cities are included in both groups, it appears to indicate that the characteristics of the epidemics tend to be similar in different places in the United States.

Figure 48 shows excess death rates from influenza-pneumonia and from all causes in the several groups of cities, by weeks from September 1918 to the summer of 1956.

As already indicated, the periods of practically every epidemic of influenza and pneumonia that appear in the middle section of figure 48 have a small epidemic-like peak in the bottom section for causes other than influenza and pneumonia, corresponding approximately in time with the influenza peak in the middle section of the chart. There are a few summer peaks in the "other causes" when no influenza epidemic is present; investigation indicated that these small, usually 1-week peaks, were from some cause other than influenza; occasionally they were caused by deaths due to several days of extremely hot weather. The dates on the chart for these 1-week summer peaks are in italics to indicate that they are unrelated to influenza epidemics (*83*).

The next question that arises is, What are the causes other than influenza and pneumonia that show these small peaks when an epidemic of influenza occurs? The top section of figure 49 shows, on a very small scale, the weekly excess death rates from influenza and pneumonia in the whole period from September 1918 to the middle of 1956, together with all causes of

Figure 47. Comparison of the curves of weekly excess mortality from influenza-pneumonia and from all causes during the various epidemics and in different groups of cities in the United States, 1922–44.



death and 7 diseases or disease groups, 6 of which are definitely chronic. These diseases are plotted by months, with no attempt to eliminate trend or the very obvious seasonal variation. However, it is relatively easy to see that in some years the winter season of high mortality from these chronic diseases shows small peaks superimposed upon the seasonal curve. Of course, the curve for all causes shows peaks because it includes influenza and pneumonia as well as other causes. However, 5 of the 6 chronic diseases show small peaks in various years and at approximately the periods of the epidemics as indicated by excess death rates from influenza and pneumonia; cancer shows no trace of excess death rates such as appear for the other chronic diseases. Puerperal septicemia and other acute complications of pregnancy and childbirth show peaks in the early years when, as in 1918, the childbearing ages suffered high pneumonia complications with resulting high mortality rates. However, the less severe epidemics of the last half of the period covered by the chart do not seem to have influenced puerperal mortality.

What, then, is the explanation of these small "epidemics" of chronic disease? Deaths, as tabulated in the United States and in most other countries, relate to the "primary cause," and the primary cause is usually defined as the cause that initiated the train of circumstances that resulted in death (*84*, *85*). Since a patient with a "bad heart," for example, is an easy victim of pneumonia, when influenza-pneumonia strikes, the prognosis is poor, and if the patient dies, the heart disease is likely to be credited as the primary cause since it would usually be first in the train of circumstances that led to the death of the patient. This would also be true for the other chronic diseases shown in figure 49 except cancer, which shows no peaks and no seasonal variation.

Influenza-Pneumonia as a Contributory Cause

Death rates from influenza and pneumonia in this study and elsewhere usually include only sole or primary causes of death. From the tabulations of deaths in the 10 cities surveyed in connection with the study of the 1928–29 epidemic, deaths in which influenza-pneumonia was classified as contributory to some other cause were also tabulated but were used as a separate group. In figure 50, death rates by age are shown separately for influenza-pneumonia as a sole or primary cause and as a contributory cause for both the epidemic period of December 1928–February 1929 and the corresponding months in the preceding nonepidemic period of 1927–28. The death rate based on influenza-pneumonia classified as a contributory or secondary cause has about the same relative age distribution as the death rate for influenza-pneumonia which was classified as the sole or primary cause of death (*86*).

Of the total excess deaths from influenza-penumonia during the 3 months of the 1928–29 epidemic, 63.4 per 100,000 population were classified as the sole or primary cause of death, and 16.3 per 100,000, or 26 percent of the sole or primary total, were classified as contributory causes; of the total of sole, primary, and contributory influenza-pneumonia deaths of 79.7 per 100,000 population, 20 percent were contributory causes. From data on mortality in figure 48, one would expect that there would be numerous deaths charged to causes other than influenza and pneumonia in which influenza-pneumonia would be entered as a contributory cause; however, the tabulations showed that not all excess deaths from causes other than influenza-pneumonia were designated as contributory to influenza. From figure 49, one would expect that in many of these excess deaths, whether or not designated as contributory causes, the primary cause would be recorded as a chronic disease. Such diseases would usually have existed much longer than the influenza and thus would have been regarded as the primary cause in the sense that the chronic disease started the train of circumstances that led to the death. Nevertheless, the death probably would not have occurred at this particular time had influenza not intervened.

Total Excess Death Rates

With excess death rates computed by weeks, the excess deaths for a whole epidemic can be

Figure 48. Weekly excess mortality (annual basis) from all causes, influenza and pneumonia, and all other causes in groups of large cities in the United States, 1918–56.

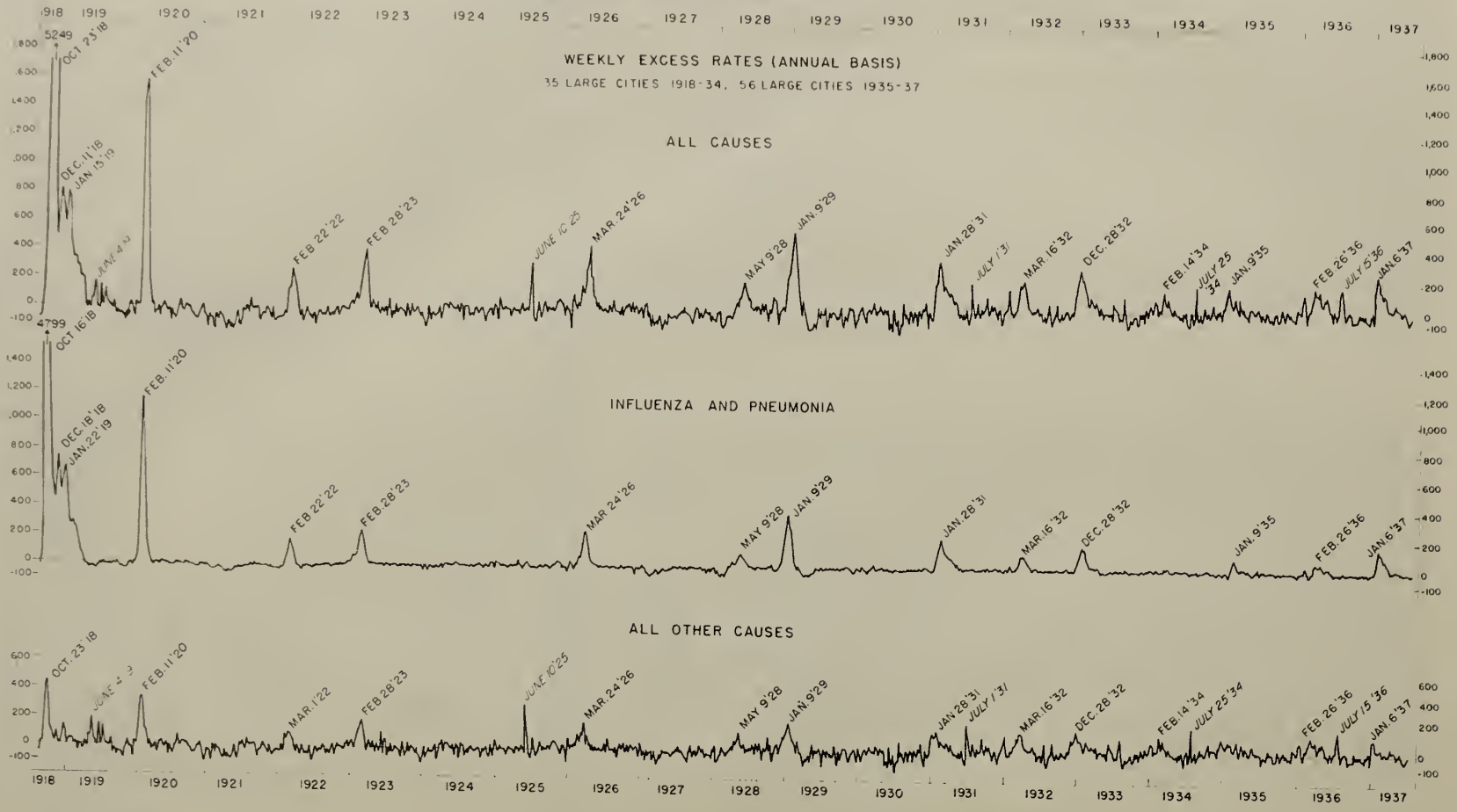
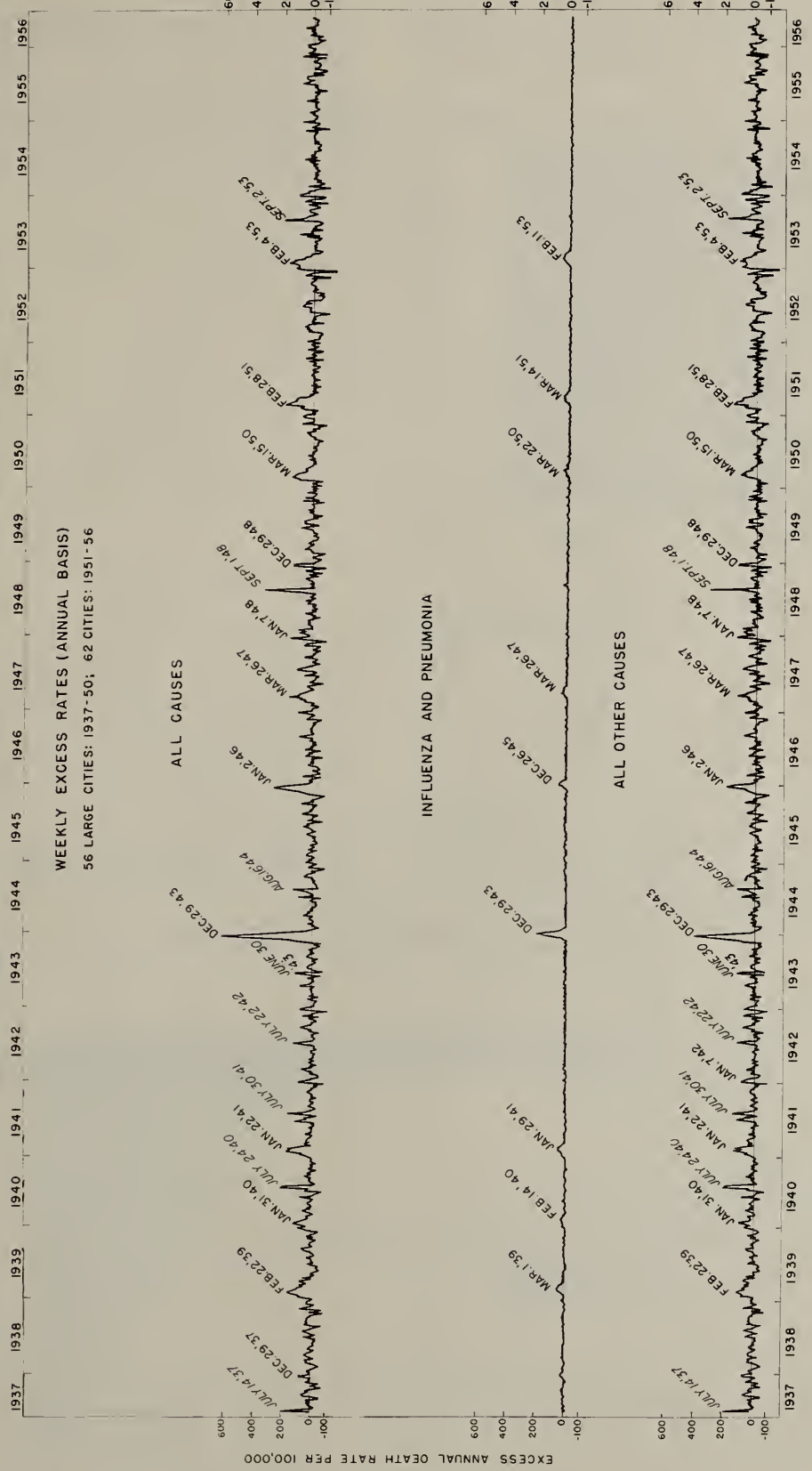


Figure 48. Weekly excess mortality (annual basis) from all causes, influenza and pneumonia, and all other causes in groups of large cities in the United States, 1918–56.—Continued



obtained by adding the weekly excess rates for the weeks that were above seasonal expectancy. However, the weekly excess rates are computed on an annual basis and so must be reduced to an actual basis by dividing their sum by the factor by which the weekly rates (or numbers)

Figure 49. Weekly excess mortality (annual basis) from influenza and pneumonia, and total monthly mortality (annual basis) from all causes and from important diseases, 1918–55, inclusive.

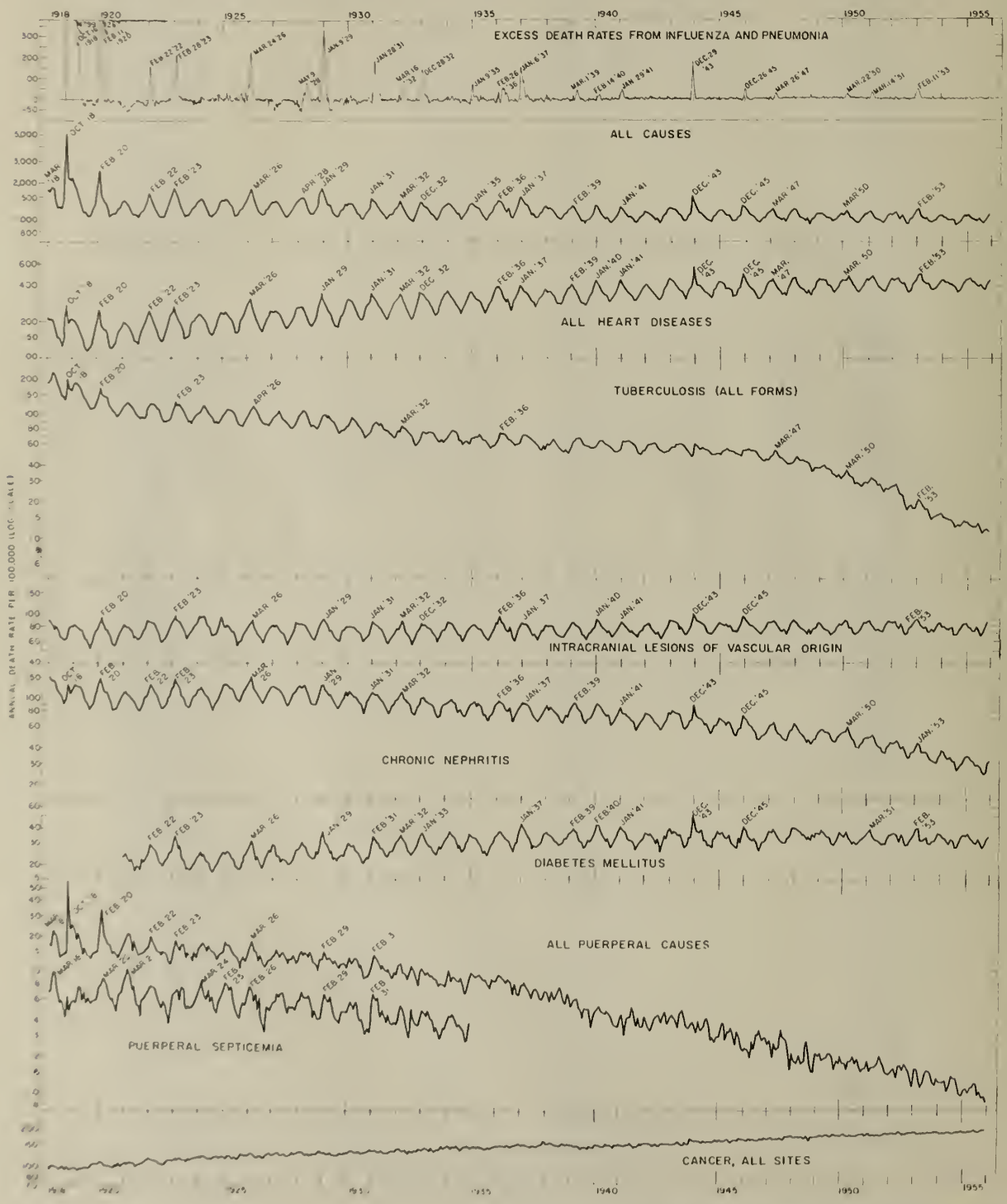
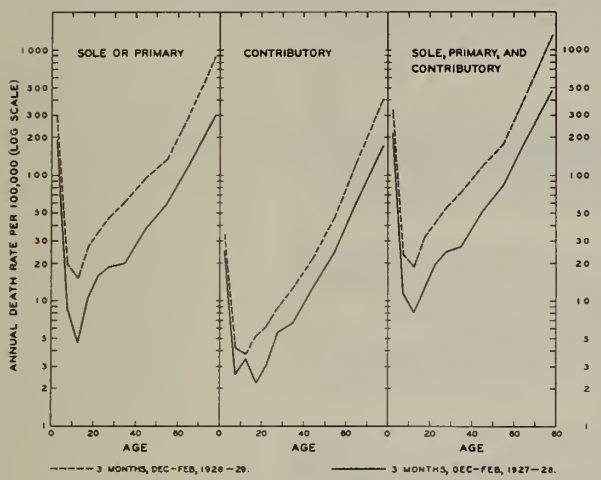


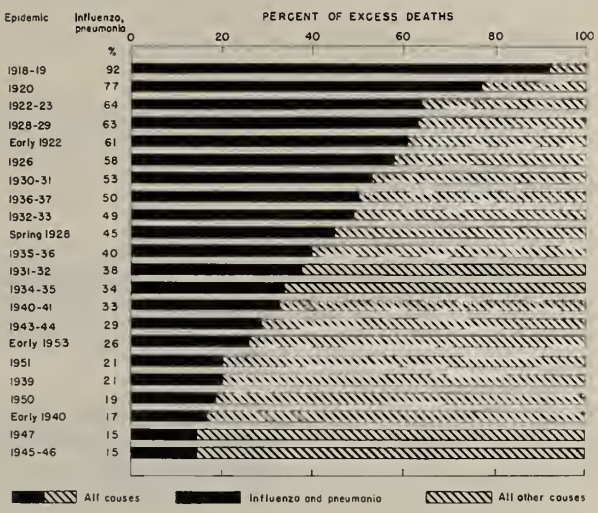
Figure 50. Annual age-specific mortality from influenza-pneumonia certified as the sole or primary cause of death; as a contributory cause only; and the total deaths in which influenza-pneumonia was a sole, primary, or contributory cause—whole populations of 10 cities included in a sample survey of illness from influenza-pneumonia during the 3 epidemic months of December-February, 1928–29, compared with the nonepidemic period of December–February 1927–28.



were multiplied to put them on an annual basis. This factor would be approximately 52 for weekly rates and approximately 12 for monthly rates, although it would change slightly according to the number of days in a given month.

Figure 51 shows the actual total excess death rates for the whole of each epidemic, arrayed

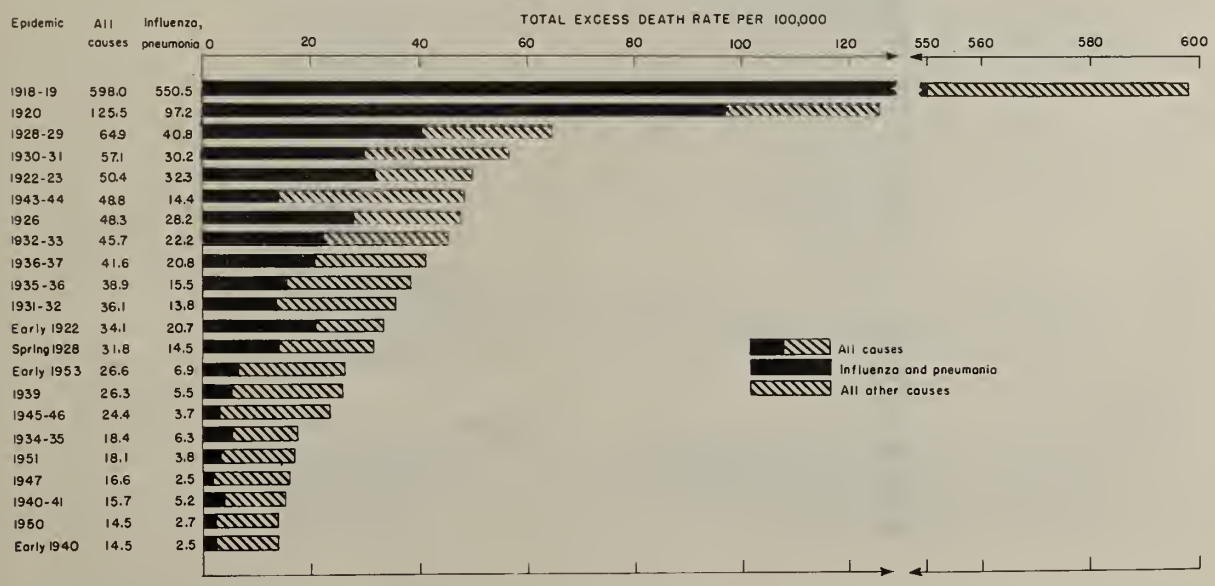
Figure 52. Percent of excess mortality from all causes that was credited to influenza and pneumonia, and to all other causes during the whole of each epidemic, 1918–56.



by these total excess rates. The epidemics range from 598 excess deaths from all causes per 100,000 population during the 1918–19 pandemic to 14.5 for each of the very small epidemics of 1950 and early 1940. Corresponding rates for excess deaths charged to influenza and pneumonia were 550 and 2.5 per 100,000 population for the epidemics of 1918–19 and early 1940.

An examination of figure 51 reveals that, in general, the smaller the epidemic in total ex-

Figure 51. Total actual excess mortality per 100,000 population from all causes, influenza and pneumonia, and other causes during the whole of each epidemic, 1918–56.



cess death rates from all causes, the higher the proportion of that excess that is charged to causes other than influenza and pneumonia. This is more easily seen in figure 52, in which the epidemics are arrayed by the percentage of the total excess deaths that were charged to influenza and pneumonia. Thus, in the pandemic of 1918–19, influenza-pneumonia was recorded as the primary cause of death in 92 percent of the excess fatalities, whereas in each of the

Figure 53. Total actual excess mortality per 100,000 population from all causes, influenza and pneumonia, and all other causes during the whole of each epidemic in large cities of four geographic regions of the United States, 1935–56.

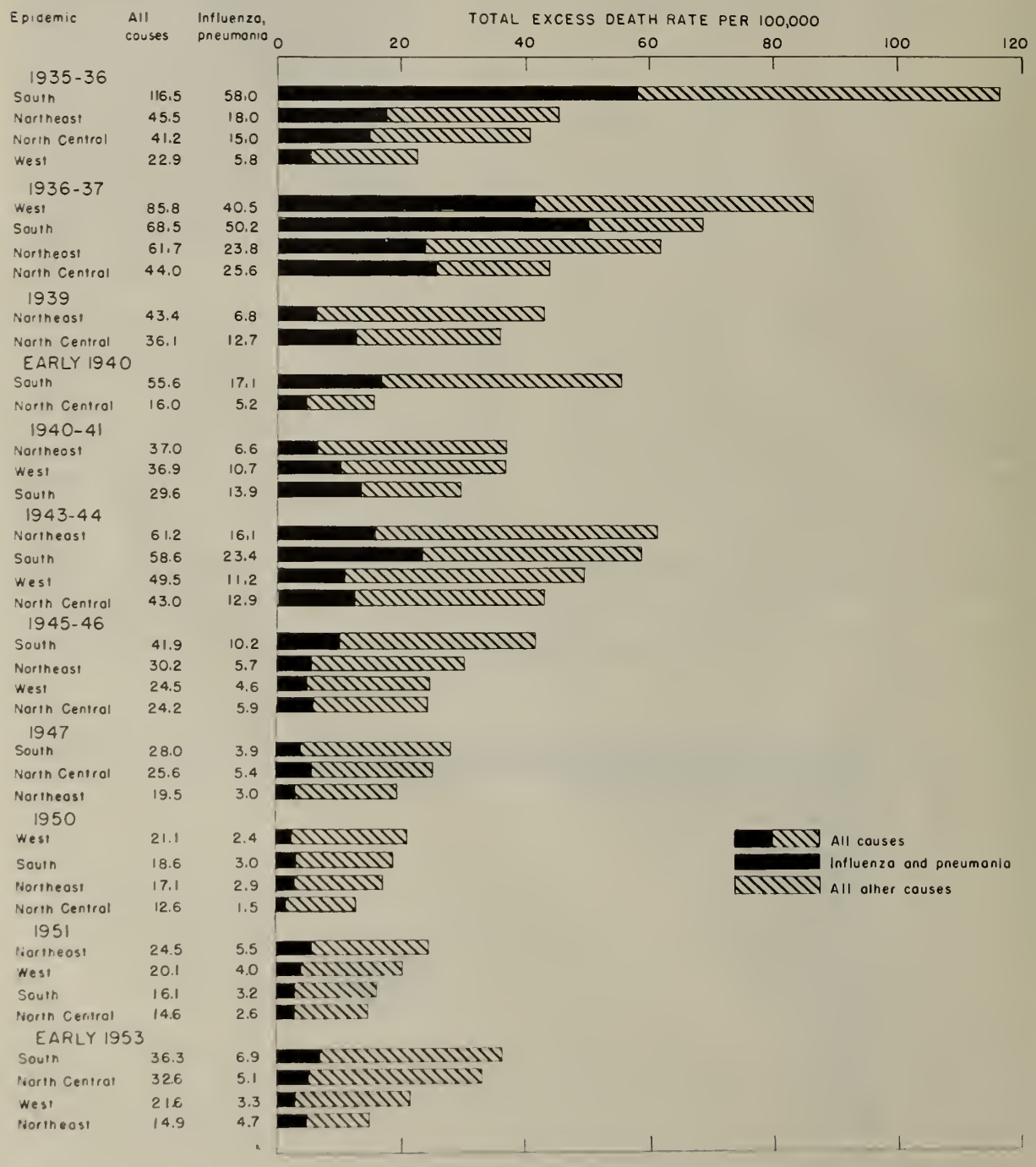


Figure 54. Percent of excess mortality from all causes that was credited to influenza and pneumonia, and to all other causes during the whole of each epidemic in four geographic regions of the United States, 1935–56.

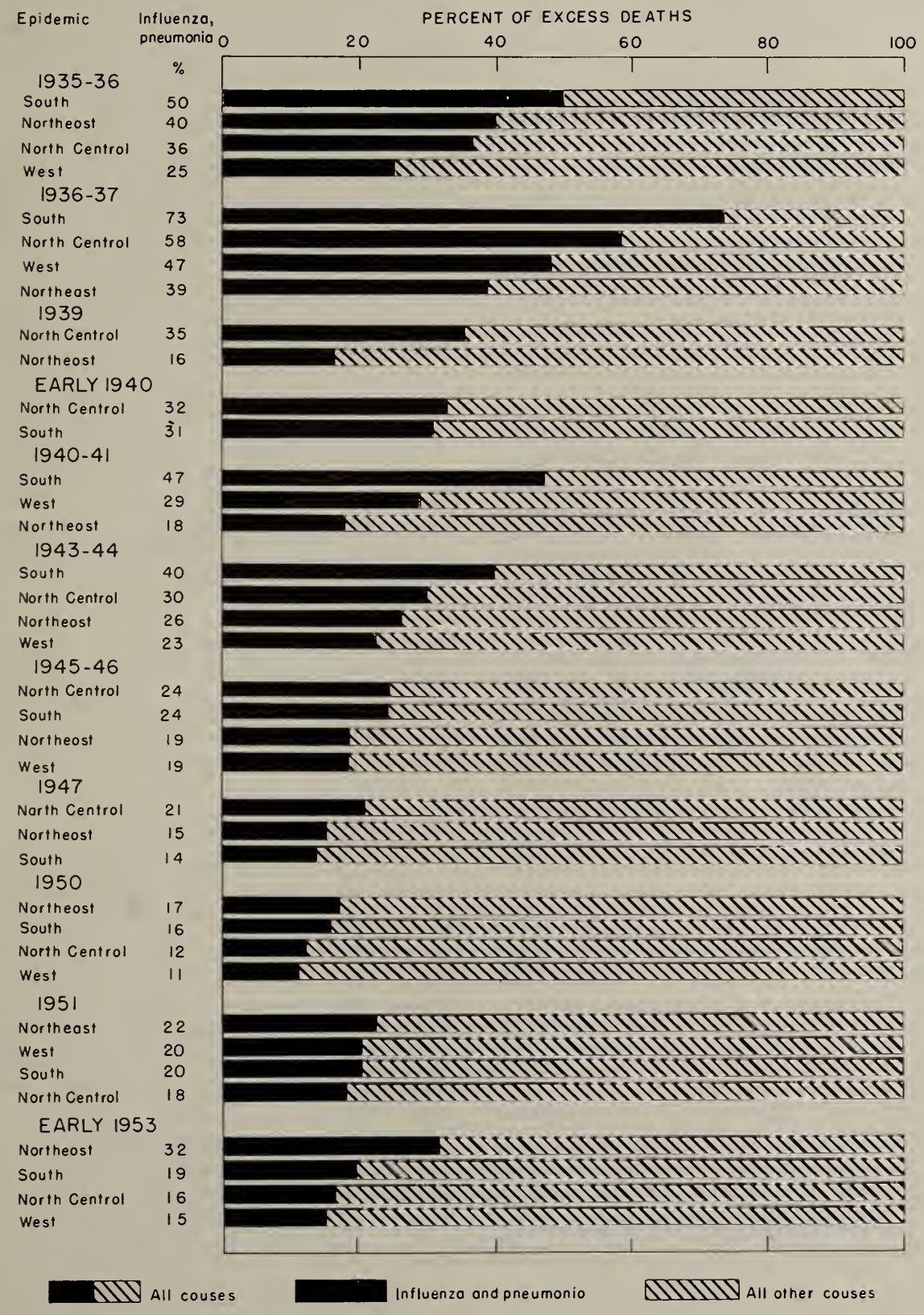
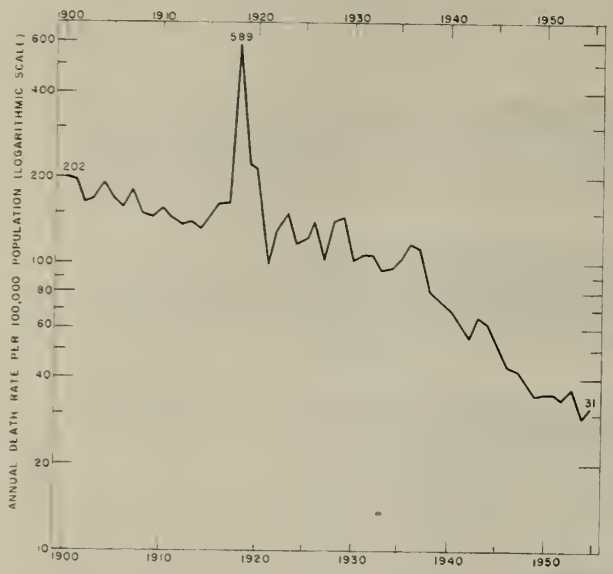


Figure 55. Trend of the annual death rate from influenza and pneumonia in the death registration States of the United States, 1900–55.



NOTE: See p. 45, for method of adjusting data for changes made in 1948 in the International Classification of Causes of Death.

small epidemics of 1947 and 1945–46, only 15 percent of all excess fatalities were charged to influenza and pneumonia.

Figure 53 shows total excess death rates for each of the 11 epidemics from 1935–36 to early 1953, inclusive, for a group of cities in each of four large geographic regions or in as many of them as had rates in excess of the usual expectancy. There is much variation in the total excess death rates for influenza and pneumonia and also for all causes. No one or two geographic sections have any monopoly on the highest or the lowest excess rates; in the 11 epidemics shown in figure 53, the South was highest in excess death rates from all causes in 5 epidemics, the Northeast in 4, and the West in 2. In the same 11 epidemics, the North Central section was lowest in excess from all causes in 7 epidemics, the Northeast in 2, and the South and West in 1 each.

As shown in figure 54, in four epidemics the South and the North Central section each had the highest proportion of total excess death rates credited to influenza and pneumonia; in three epidemics, the Northeast section had the highest proportion.

In summary, epidemics of influenza and pneumonia have been decreasing in total excess death rates in a reasonably consistent way since the great pandemic of 1918–19. Figure 55 indicates that, except for the pandemic years 1918–19, the general trend of annual death rates from influenza and pneumonia in the death registration States, including the total continental United States in 1933 and later years, has been downward. The rate of decrease was moderate during the period 1900 to about 1937 but has been considerably more rapid since that time. In 1900, the annual death rate from influenza and pneumonia was 202 per 100,000 population in the registration States; in 1955, it was only 31 per 100,000, a decrease of 85 percent in the 55 years. The 1900 rates were not out of line with those for years immediately following nor were the 1955 rates out of line for immediately preceding years. (See page 45 for an explanation of adjustments made in 1949–55 data because of changes in the International Classification of Diseases and Causes of Death made at the sixth revision conference in 1948.)

Age Variation of Mortality in Different Epidemics

So much research has been done on the age incidence of and mortality from epidemic influenza that a brief summary of that aspect of the outbreaks seems appropriate.

Computation of Excess Death Rates

Although copies of death certificates for the whole United States are received and tabulated in the National Office of Vital Statistics of the Public Health Service, tabulations by age and sex for weeks or months for the total United States, or even for a fair-sized sample, by State, city size, age, sex, and other factors needed in a thorough study of mortality during influenza epidemics would be a large undertaking. Therefore, such detailed tabulations have not been made nor have tabulations by age, sex, and month of death been made. However, the deaths from important causes (including influenza and pneumonia) are tabulated by month of death for all ages combined, and by

age and sex for the year as a whole. Thus, influenza-pneumonia death rates for all ages combined in epidemic months can be compared with similar rates for the same months in a nearby year without an epidemic. If the corresponding nonepidemic months of the 2 years had about the same rates for all ages combined, the excess for all ages would be reasonably accurate. However, the age distribution of deaths during the epidemic might be different from the age distribution during the nonepidemic period; but if the death rates from influenza and pneumonia for all ages are reasonably comparable in nonepidemic years and in nonepidemic months of epidemic years, the death rate for the whole of each of the 2 years can be computed by age, or by age and sex, and subtracted from or in other ways related to similar rates for the epidemic year to obtain a reasonable estimate of excess death rates in the epidemic year per 100,000 population.

Data from the 1928–29 influenza epidemic illustrate the method described in the preceding paragraphs. The Public Health Service canvassed samples of 10 large cities immediately after that epidemic and also obtained from the vital statistics offices of each of the 10 cities a record of all deaths from influenza-pneumonia during the 3-month period of the epidemic, with age, sex, dates of death and birth, and other characteristics, together with similar data for the 3 corresponding months of the year prior to the epidemic and similar data for the calendar years 1927 and 1930. Death rates by age were computed and plotted for both 3-month periods, and for 1928 and 1929, the epidemic years, and 1927 and 1930, the normal years (fig. 56). Rates for the 2 normal periods (solid lines in middle and right boxes) were subtracted from the rates for corresponding periods, including the epidemics (dash lines, middle and right boxes), and these

Figure 56. Excess death rates from influenza and pneumonia computed from deaths during the 3 months of the epidemic and the corresponding months of the preceding year, as compared with deaths during the 2 calendar years which included the epidemic and the calendar years immediately preceding and following those two years; epidemic of 1928–29 in 10 cities in the United States.

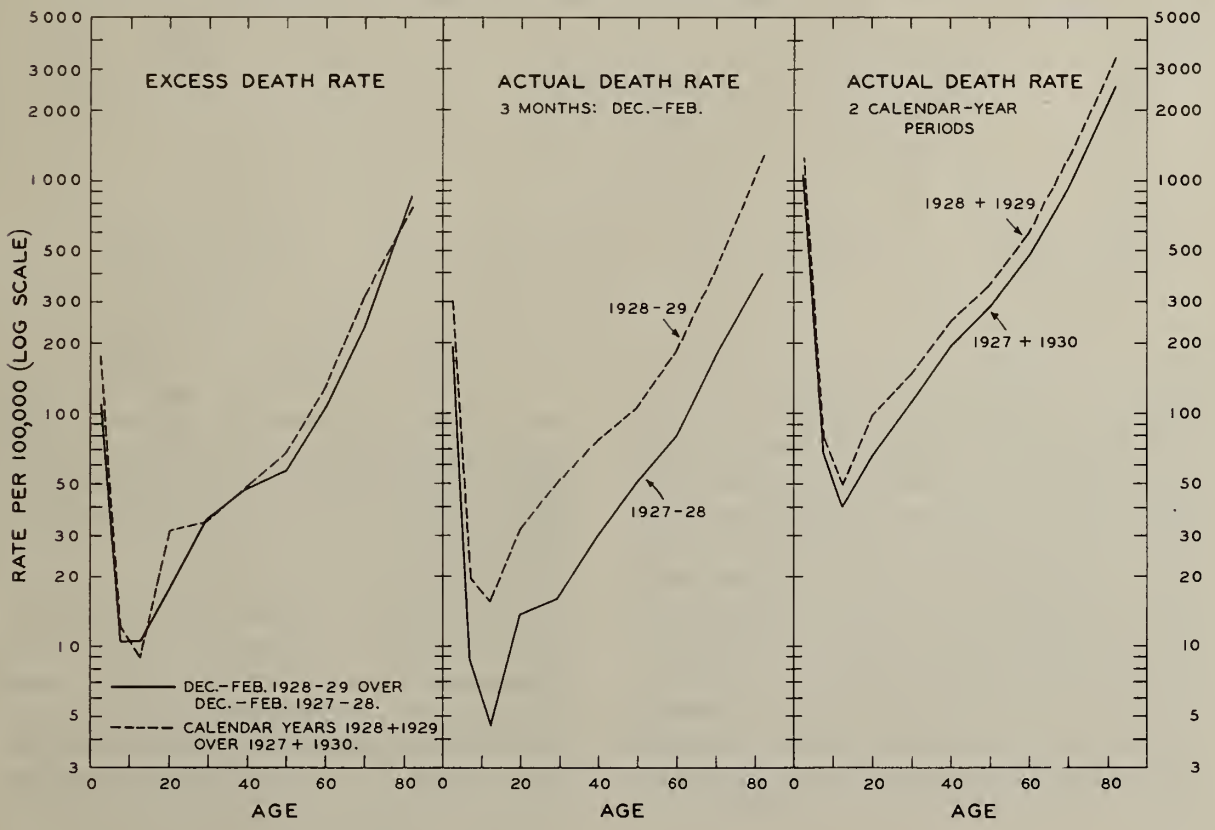
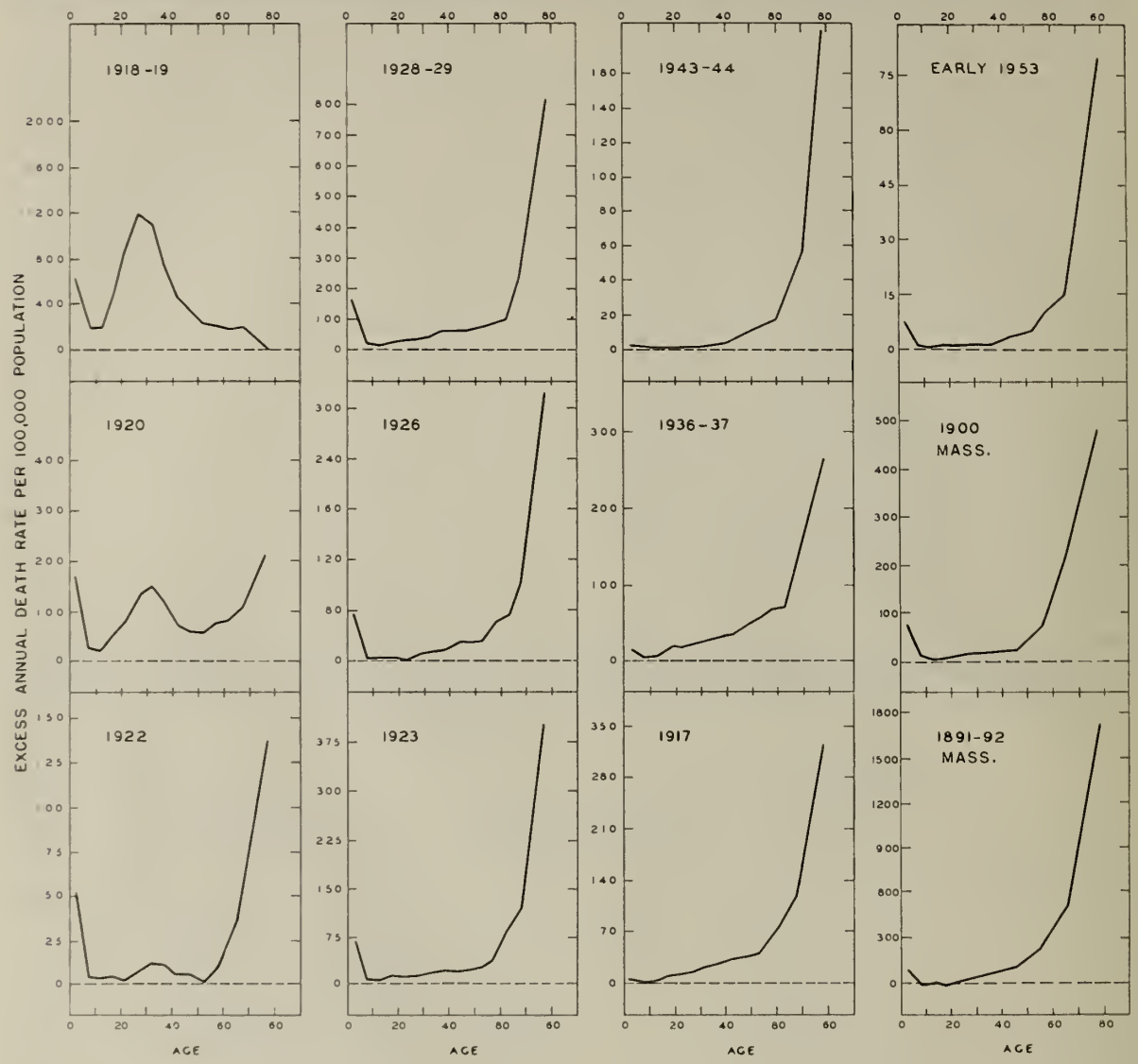


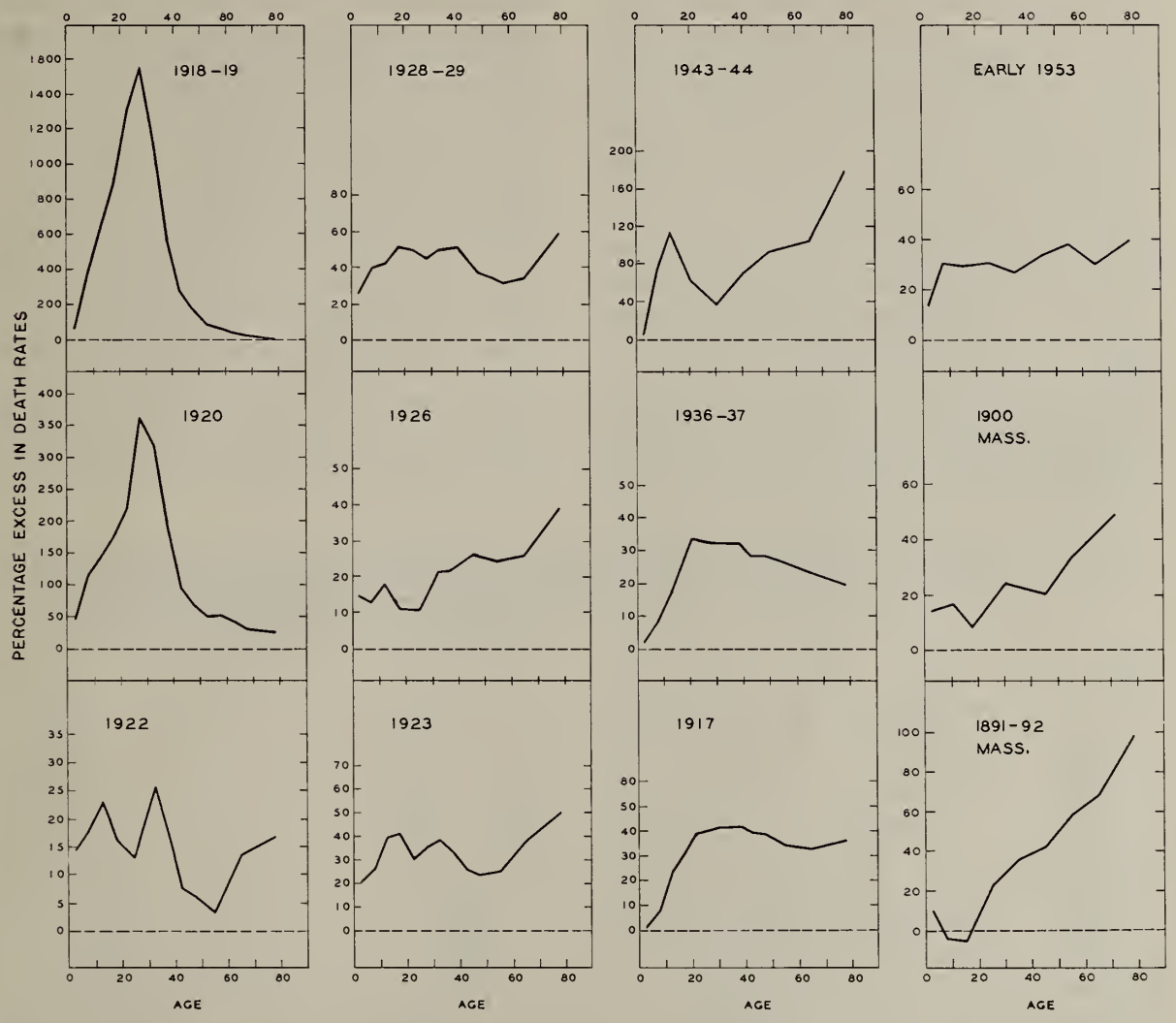
Figure 57. Comparison on an arithmetic vertical scale of the age curves of excess influenza and pneumonia mortality during certain calendar years when influenza was epidemic in the United States, 1891–1956.



differences (representing excesses) were plotted in the left box, in which the dash line represents differences between the rates for the 2-calendar-year periods and the solid line represents the differences between the rates for the two 3-month periods. While the two curves are not identical, there is little doubt that their differences are not significant. Thus, this less precise method gives reasonably accurate results if used with care, especially in selecting the years to be compared. By this method approximate excess death rates from influenza and pneumonia for almost any epidemic year can be computed because all the data needed for the computation are published in the annual vital statistics reports from the National Office of Vital Statistics of the Public Health Service.

In the absence of more detailed data, excess death rates from influenza and pneumonia were estimated by comparing age curves of influenza-pneumonia mortality based on whole calendar years. These data are plotted as age-specific excess death rates per 100,000 population in figure 57 on arithmetic scales; in figure 58, as percentage excesses at different ages; and

Figure 58. Comparison on an arithmetic vertical scale of the age curves of the percentage excess in influenza-pneumonia mortality during certain calendar years when influenza was epidemic in the United States, 1891–1956.



in figure 59, as excess death rates on logarithmic vertical scales.

Figure 57 shows the age curves of excess influenza and pneumonia mortality in 12 epidemics, including two early ones from the Massachusetts data and the 1953 epidemic from the 62-city data. With the exception of the epidemics of 1918–19, 1920, and to a minor extent, of 1922, the age curves are all similar, with high excess rates at the oldest age and some increases under 5 years, with low rates for intervening years, particularly for the ages under 35, which in 1918 included the extremely high young adult peak.

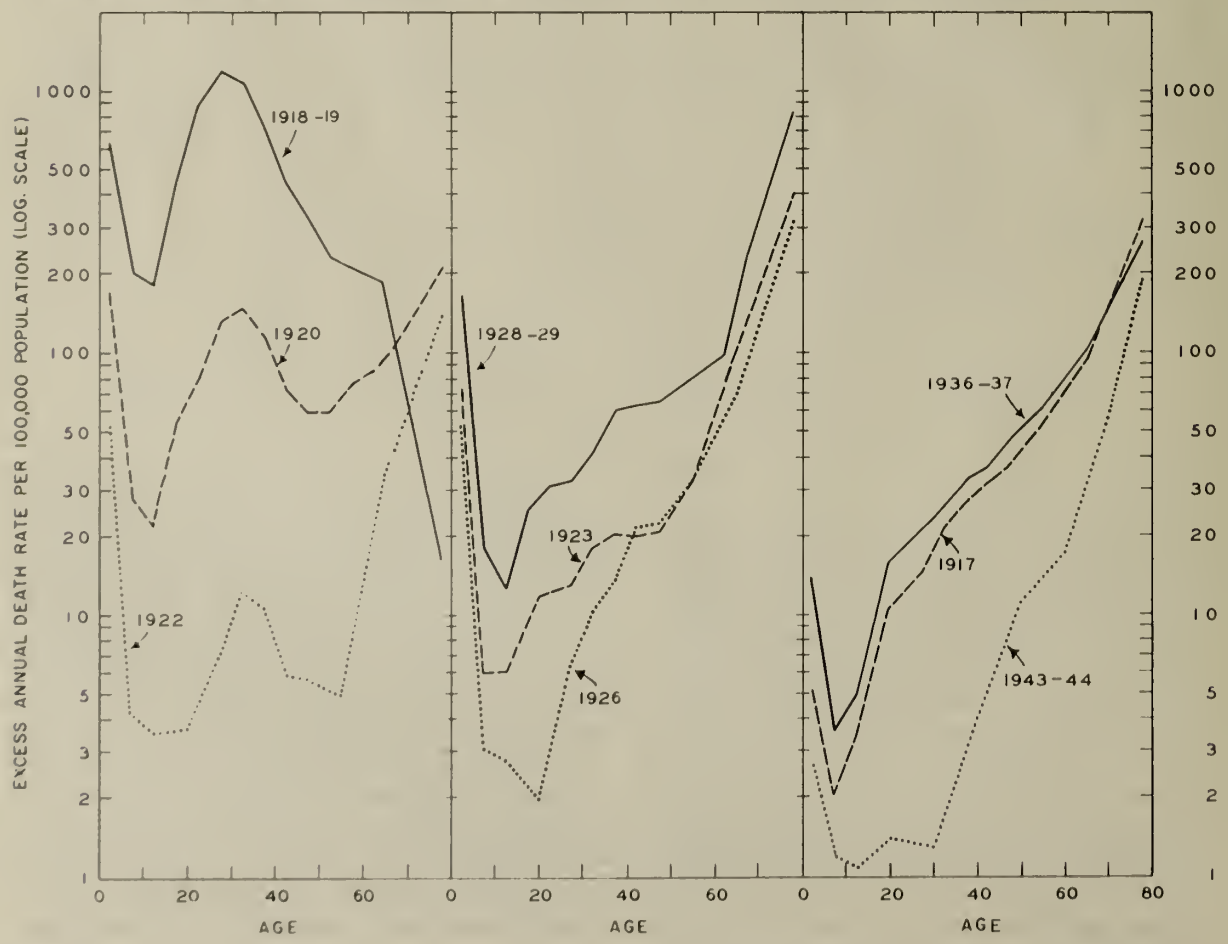
Figure 58 shows excess influenza and pneumonia death rates in still another way, namely, the percentage that the excess influenza and pneumonia mortality rate at a given age in the epidemic year is above the corresponding rate in a nearby nonepidemic year. This method gives quite different age-curves of mortality, in which the 1918–19 and 1920 excess curves are almost identical in appearance but not in actual percentage excesses at the different ages. Since the usual curve of pneumonia, which is the real cause of influenza mortality, is high at the extremes of life, the high rates at those ages in epidemic years are not a high percentage above the high rates of normal years. In the young adult ages, mortality from pneumonia

is normally low, so when there is a young adult peak in mortality in the epidemic the rates for this age group are a very high percentage above the usual low nonepidemic rates. Thus, the most prominent characteristics of the age curves of percentage excesses in the 1918–19 and 1920 epidemics are the young adult peaks, which are far higher than the percentage excesses at any other age.

Figure 59 shows for epidemic years the influenza and pneumonia excess death rates over nearby years during which no special epidemics occurred. These data are plotted on logarithmic vertical scales, which show relative rather than actual differences. Figure 60 shows age curves of total influenza and pneumonia mortality for the 3 calendar years which included the largest influenza epidemics of the last half century, and the age curves of the same diseases for 1914 and 1924, when no general influenza epidemics occurred in the United States.

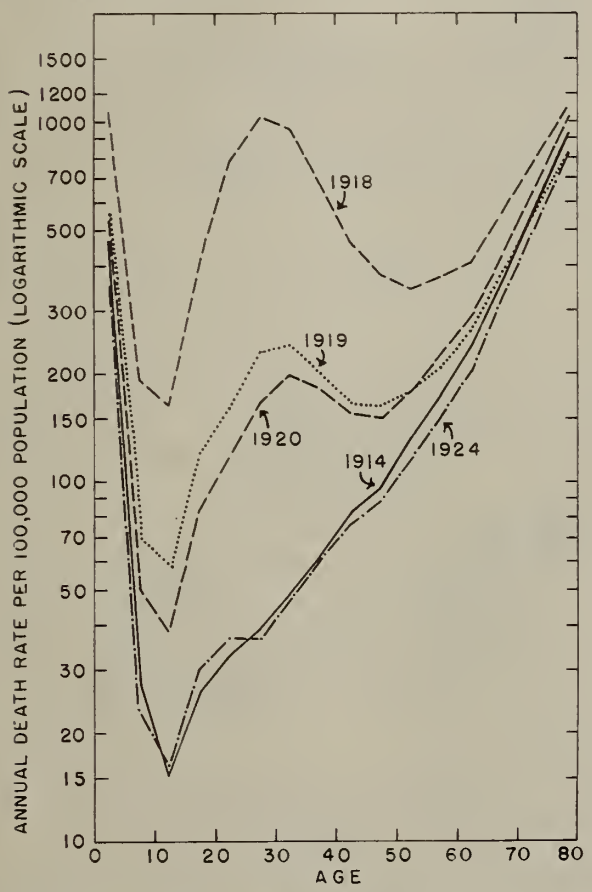
Comparison of figures 59 and 60 shows that in 1918 the annual influenza and pneumonia death rates for persons under 5 years and 25–29 years of age were about the same and were of the same order of magnitude as the excess rates at 25–29 years in the epidemic of 1918–19. However, in excess death rates in the epidemic of 1918–19 (fig. 59), the excess rate at the young adult peak was considerably higher than the excess rate among children under 5 years of age. Similarly, the total influenza-pneumonia death rate among persons over 70 years of age (fig. 60) was about as high as the young adult peak (25–29 years) of total death rates, but the excess rate (fig. 59) at 70 years and over was extremely low.

Figure 59. Comparison on a logarithmic vertical scale of the age curves of excess influenza and pneumonia mortality during certain calendar years when influenza was epidemic in the United States, 1917–44.



In both 1919 and 1920, the total death rates from influenza and pneumonia at the young adult peaks (fig. 60) were considerably lower than the total rates at the two extremes of life. Data were not obtained for the 1919 excess death rates, except as a part of the 1918–19 epidemic, but in 1920 the excess rates at both extremes of life were above those of the young adult peak. In the 1922 epidemic, there was a very minor peak at the young adult ages, with rates at both extremes of life that were far above the young adult peak (fig. 59). Excess mortality rates represented by the three curves in the middle box were higher among children under 5 years of age than among young adults. After 1922, the usual age curve of influenza and pneumonia mortality reappears, with very little evidence of any tendency toward young adult peaks.

Figure 60. Comparison on a logarithmic vertical scale of the age curves of annual influenza and pneumonia mortality during 3 calendar years with large influenza-pneumonia excess deaths and 2 years without appreciable epidemics—1914–24.



Age Incidence of Total Cases and of Pneumonia

Thus far, attention has been centered upon influenza-pneumonia mortality, because mortality records are available for all years. However, special surveys of respiratory diseases have been made after various epidemics covering from 1 or 2 to 10 or more selected localities. In addition, general illness surveys have been in progress when influenza epidemics occurred and the data on influenza, severe colds, and pneumonia have been tabulated separately for the period of the epidemic.

Figure 61 shows age curves of illness from influenza and related diseases during several major and minor epidemics. In the upper left box are age curves of these diseases in several epidemics in Baltimore. The young adult peaks in these illness rates are much less marked than in mortality, and there is much variation in the age curves in the different epidemics. The same general description applies to the data for Hagerstown and Medical Officers' Families (Army, Navy, Public Health Service, and some medical school faculty members) in the upper right box, but not so well to the Cattaraugus County and Syracuse data or to the 1939–41 epidemics in Baltimore (lower boxes). For various reasons, including lack of personnel, bad roads, and bad weather, the visits in Cattaraugus County and Syracuse were at less regular intervals, so that colds, even those confining the patient to bed, were not so frequently recalled by the informant and recorded as in surveys with more frequent contacts with the families when the visit of the field interviewer was nearer the date of the illness. On the other hand, in the 1939–41 Baltimore epidemics, influenza and colds were recorded as a part of an intensive survey with regular monthly visits so that colds confining the patient to bed were reported fairly frequently and probably influenced the age curves of total cases.

Figure 62 shows on logarithmic vertical scales some of the same data as figure 61. However, in figure 62, the diseases included are limited to influenza and grippe only, except in the mill village (upper right box). The few data on the pandemic of the fall of 1918 in one small village show the characteristic young

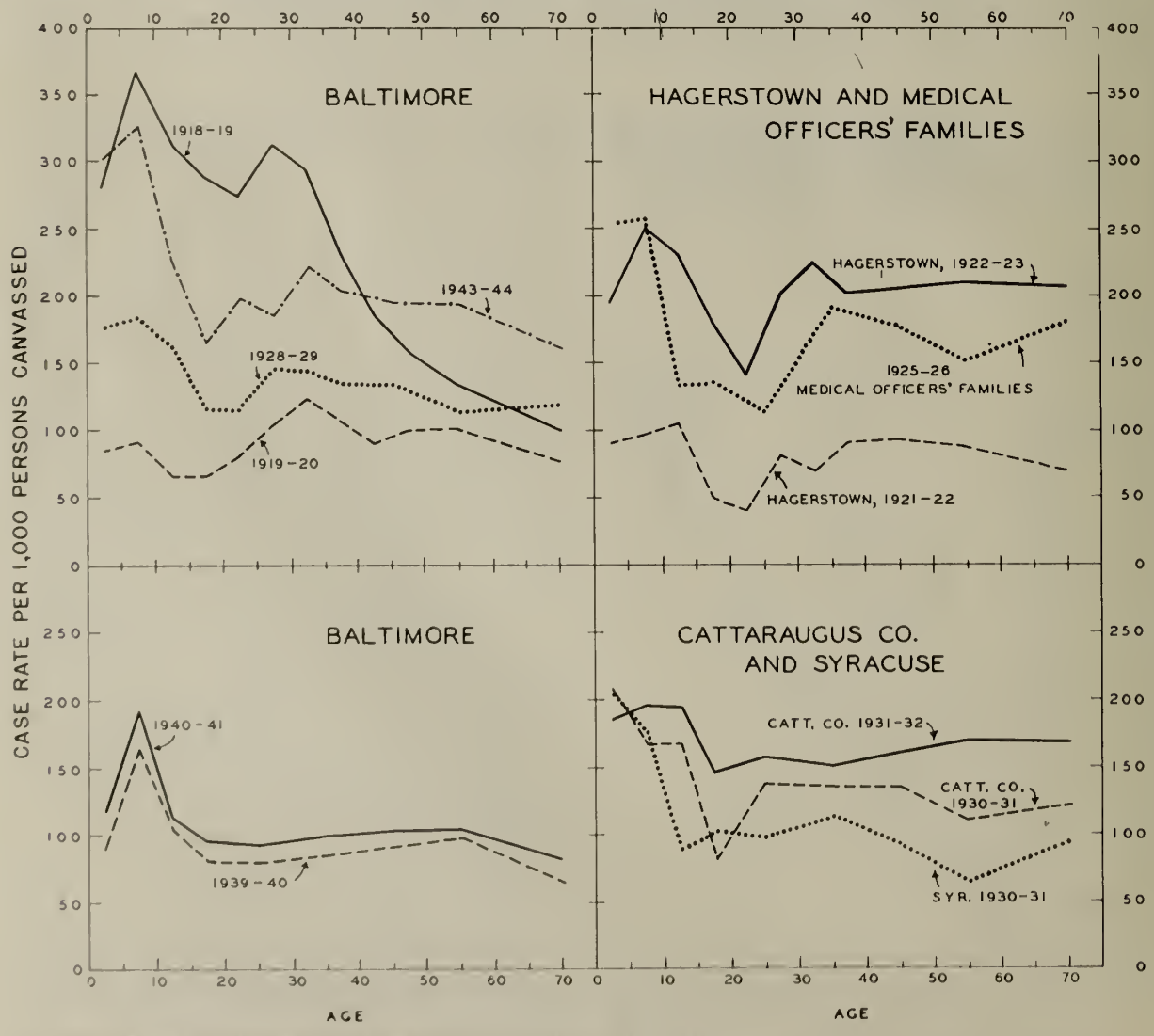
adult peak. The effect of the logarithmic scale is to show greater variability in the age curves, although some of the additional variability may be due to smaller numbers of cases since the data include only those reported as influenza or grippe.

Figure 63 shows for some of the same localities the age incidence of pneumonia and the percentages of all recorded cases of influenza and related diseases complicated by pneumonia. However, in some of the smaller surveys, pneumonia cases were too few to give age curves of any reliability.

Furthermore, in the 1918–19 epidemic, pneumonia incidence was the real source of the young adult peak in mortality, and in 1920 there was a much lower but still definite peak of a similar nature with a considerably higher peak of pneumonia complications. In the epidemics of 1928–29, 1939–41, and 1943–44 in Baltimore, and of 1922–23 in Hagerstown, there were no indications of young adult peaks of pneumonia.

The case rate of pneumonia in the Baltimore influenza epidemic of 1920 was not large, but the percentage of those cases that were com-

Figure 61. Age incidence of certain respiratory diseases during 2- to 4-month epidemic periods, as recorded by special canvasses—Baltimore and other eastern localities, 1918–44.



NOTE: Cases include influenza, grippe, pneumonia, and colds in bed.

plicated by pneumonia was almost as high as in 1918–19 (lower left box). However, the pneumonia complications were fewer in the Baltimore epidemics of 1928–29, 1939–41, and 1943–44, and in the Hagerstown epidemic of 1922–23. In a group of surveyed localities in 1918–19, about 6 percent of the total recorded cases were complicated by pneumonia, as compared with about 2 percent in 1928–29. It must be remembered that it is pneumonia that causes nearly all of the fatalities in influenza epidemics.

Figure 64 shows age curves similar to those in figure 63 but on logarithmic vertical scales. The main showing of both types of charts is that the young adult peak of influenza mortality is a reflection of the high peak incidence of pneumonia, which, as a complication of the influenza, is the killing disease.

Influenza and pneumonia rates by sex have not been considered in this study, but it is worth mentioning that in the 1918–19 epidemic in Baltimore the young adult peak at 25–29 years of age in the pneumonia case rate and in the percentage of cases complicated by pneumonia were both roughly 60 percent higher for males than for females.

Two rural areas in Maryland were surveyed in the 1918–19 epidemic. Figure 65 shows age curves for the total of influenza and related

Figure 62. Age incidence (logarithmic vertical scale) of cases reported as influenza and grippe only, during the same 2- to 4-month epidemic periods as in figure 61, as recorded by special canvasses, 1918–44 (*9, 86*).

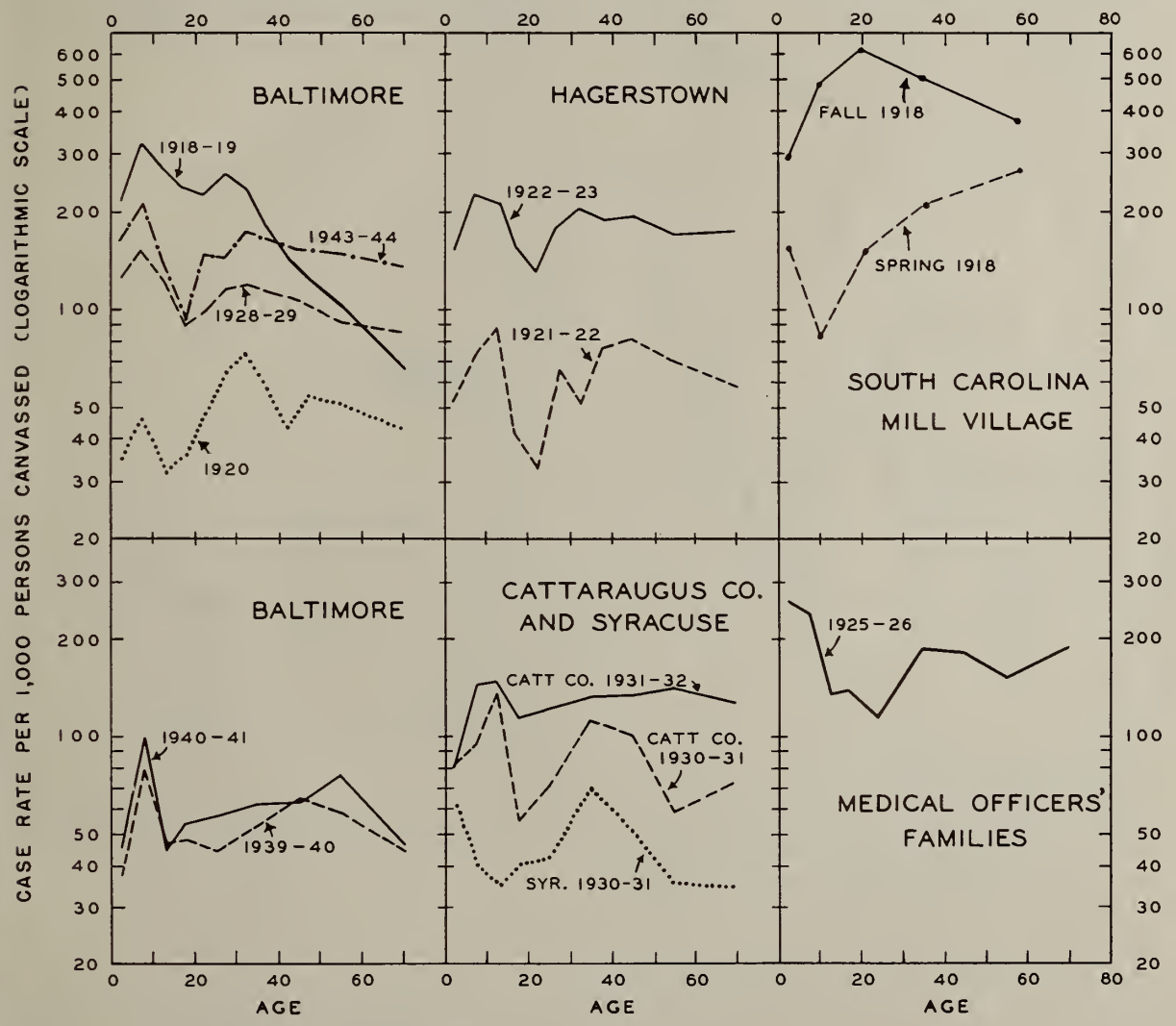
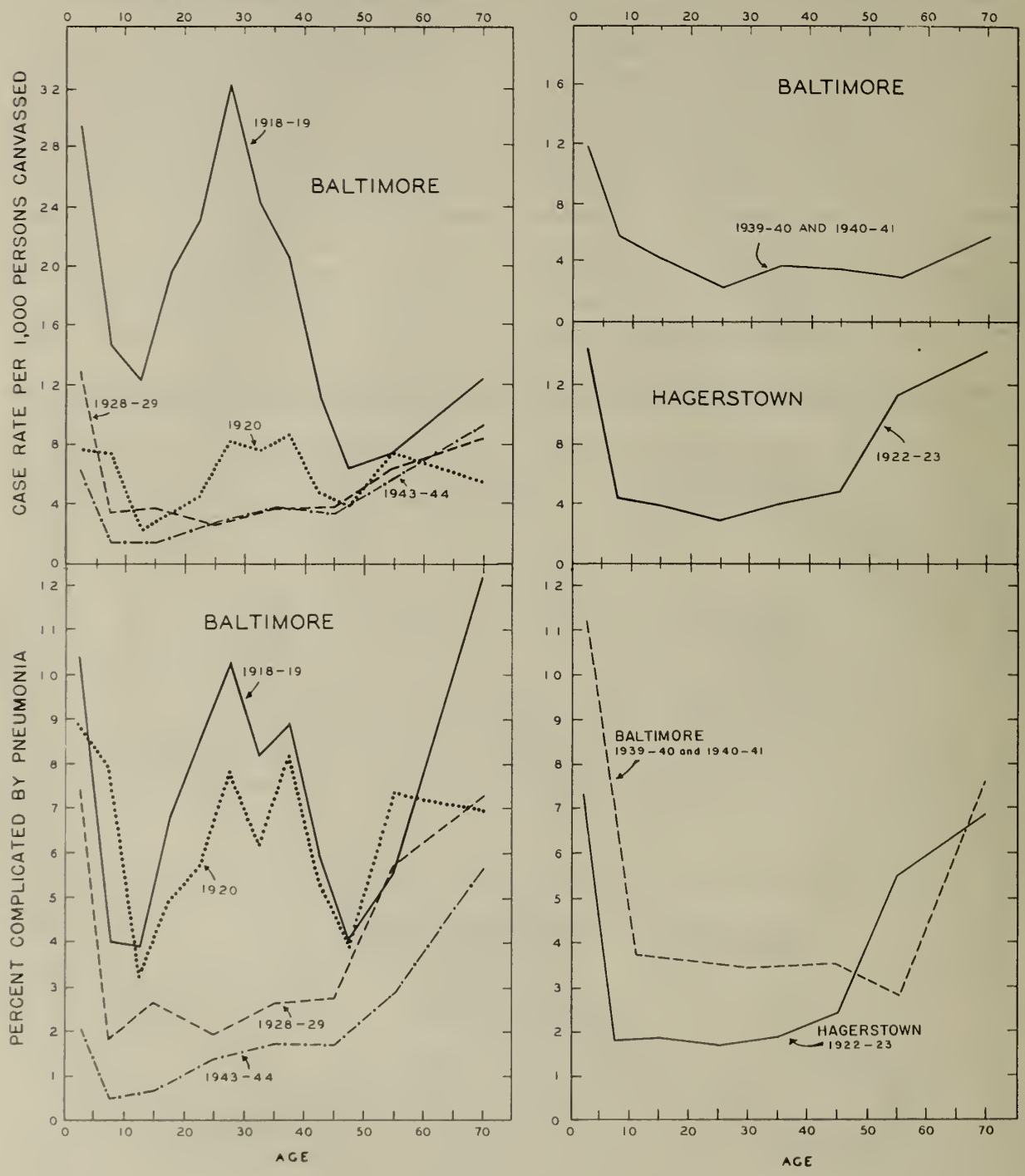


Figure 63. Age incidence of pneumonia during 2- to 4-month epidemic periods, as recorded by special canvasses, and the percentage of influenza and related diseases that were complicated by pneumonia—Baltimore and Hagerstown, Md., 1918–44.



diseases for Charles County, Md., and a group of minor Maryland towns, with comparative data for the same epidemic in Baltimore. The rates in the two rural areas are definitely and consistently above the rate for the city of Baltimore.

Pneumonia was not recorded in Charles County but data were available for comparing the pneumonia case rate in the minor Maryland towns with that in Baltimore. Here again, the surveys in the small rural towns yielded higher pneumonia case rates than in Baltimore for every age group except 65 and over. For this group, the Baltimore pneumonia rate becomes higher than in the preceding age group, whereas the rural rate continues downward. The upturn in the Baltimore pneumonia rate in the older ages seems to be real, as shown in figure 64, with the two oldest age groups having higher rates than preceding groups (*87*).

Figure 64. Age incidence of pneumonia (logarithmic vertical scale) and the percentage of influenza and related diseases that were complicated by pneumonia—Baltimore and Hagerstown, Md., 1918–44.

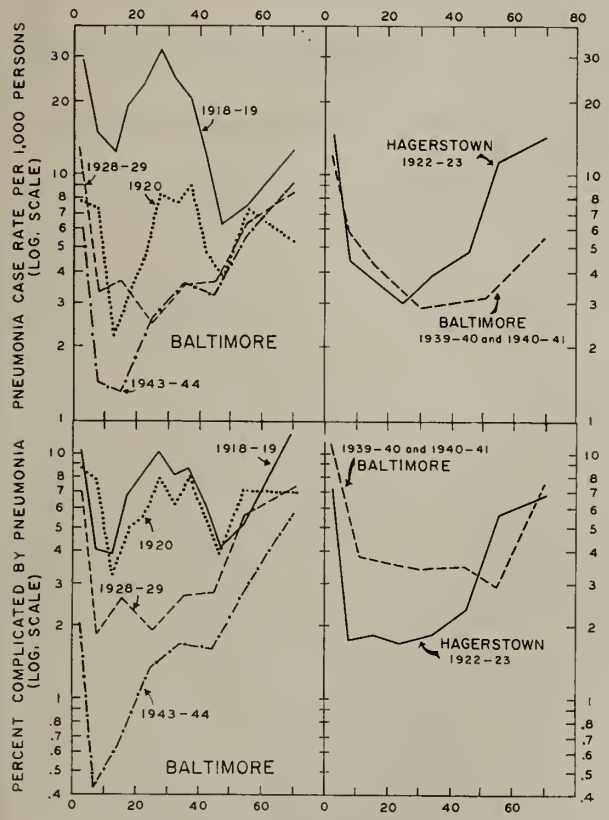
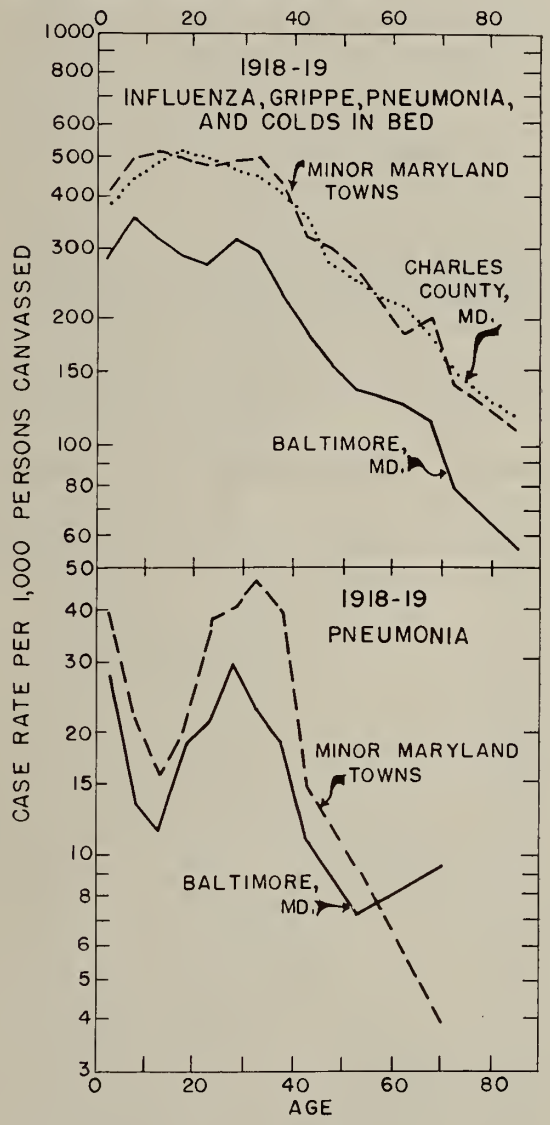


Figure 65. Age incidence of influenza and related diseases and of pneumonia in minor towns and rural areas of Maryland, as compared with that in Baltimore, epidemic of 1918–19.



NOTE: The Baltimore curves here shown are in smaller age groups than in other charts.

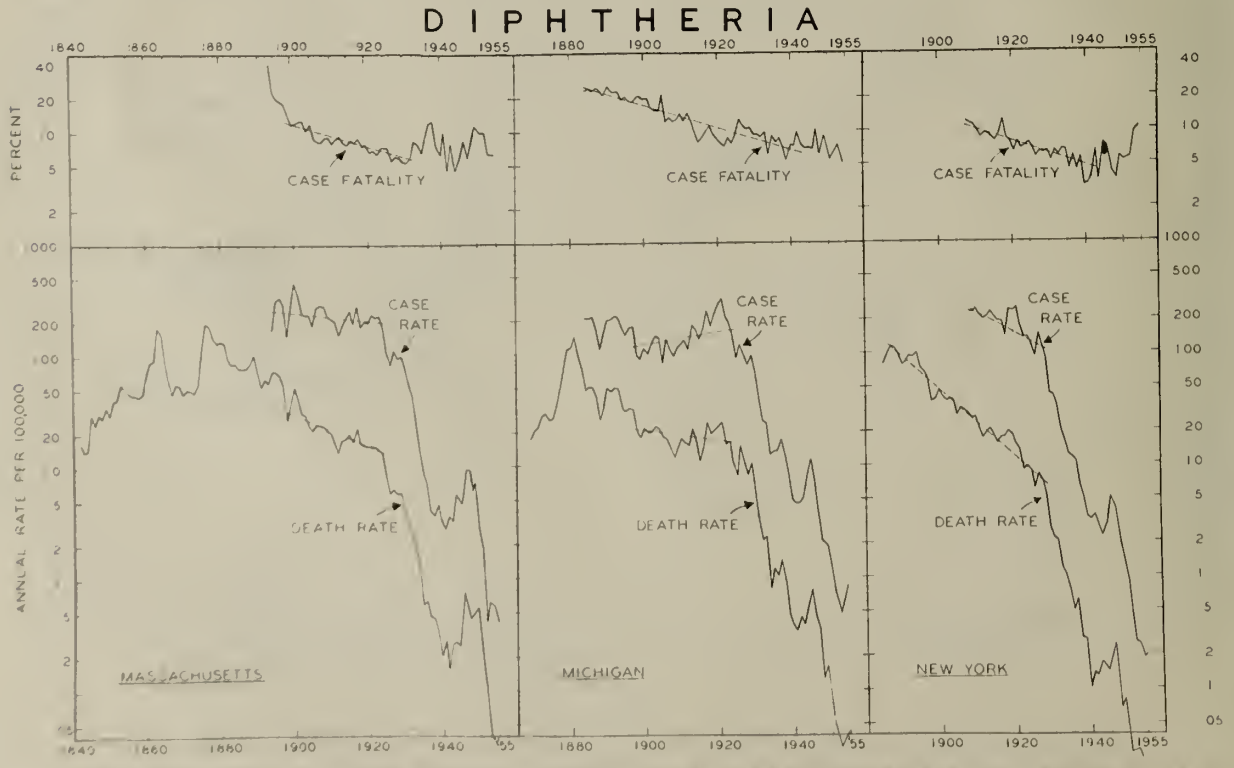
Trends of Reported Cases of Notifiable Diseases

Prior to the Congressional action of July 1956 (*42*) for a continuing health survey of a representative sample of the population of the United States, in which all types of illness would be recorded, the only continuing sickness data available are the reports of certain communicable diseases and of a few noncommunicable diseases, such as pellagra and cancer, in some States. These reports are required by State laws, so the lists of diseases to be reported are not uniform, but tabulated data for such diseases as were reportable were sent to the Public Health Service in Washington. Beginning with 1912 reports, these data were published annually, by disease, in separate pamphlets for States, large cities, and small cities. Recently, the National Office of Vital Statistics of the Public Health Service compiled these data and published them in a single report, by States and by years, from 1920 to 1950 (*88*). However, a number of States make tabulations of some reportable diseases by age and sex, and a few States have tabulated reports for important diseases as far back as 1840.

These reports vary in completeness from State to State, and from year to year in a given State but probably not as much as from State to State. However, it seems worth while to examine some trends of these reports in all States that require reporting of a given disease rather than in a few States selected for some special reason such as better reporting or more immunizations or other preventive work, although such activities vary considerably from State to State.

Of course, the true incidence of a consider-

Figure 66. Trend of diphtheria incidence, mortality, and case fatality in 3 States during 45–115 years (*89*).



NOTE: Annual rates per 100,000 population; deaths recorded by State registrars and cases reported to health departments.

able number of these diseases varies somewhat, or even a great deal, in different States and geographic sections of the country. But there are a few diseases that are confined almost entirely to certain geographic sections, and separate rates for these diseases for these sections would mean more than rates for the continental United States as a whole. Mixed with such true variation in incidence are artificial variations that arise from different types of incompleteness of the reports. Because of these facts, it was decided, with a few exceptions, to relate the reported cases of each disease to the total population of States in which the reporting of the particular disease was required by law or regulation and at least some reports were being made.

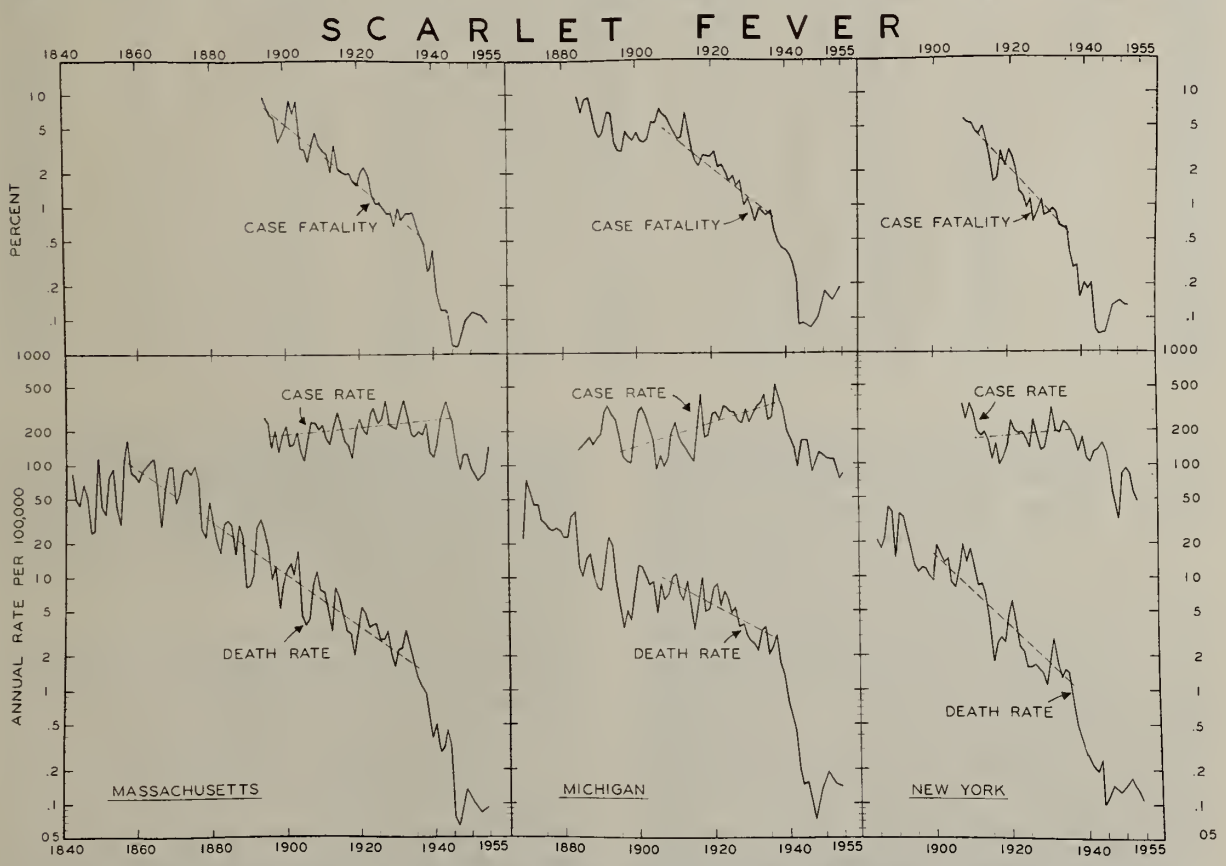
Among the diseases most definitely occurring only in limited geographic areas are Rocky Mountain spotted fever (Mountain and eastern part of some of the three Pacific States) and malaria and endemic typhus (South, generally). The annual reported case rates per 100,000 population for these and a few other diseases are shown in table 8 for the total United States and also for the geographic regions chiefly affected. Typhoid and paratyphoid fever are shown separately for 1942 and later years; before 1942, reports for these two diseases were combined. Not all of these special rates are included in the charts but the important ones are included in table 8 (pp. 76–77).

Longtime Trends of Diphtheria and Scarlet Fever in Three States

Diphtheria

Many data on diphtheria incidence have been collected by various States, probably because, although it has been brought under al-

Figure 67. Trend of scarlet fever incidence, mortality, and case fatality in 3 States during 45–115 years (*89*).



NOTE: Annual rates per 100,000 population; deaths recorded by State registrars and cases reported to health departments.

Table 8. Cases per 100,000 population for certain diseases required by law or regulation to be reported to health departments by attending physicians, 1920–55

[Adjusted for nonreporting where information is available]

Calendar year	Amebiasis	Bacillary dysentery	Brucellosis	Diphtheria	Acute infectious encephalitis	Acute poliomyelitis	Measles	Scarlet fever and streptococcal sore throat	Smallpox	Whooping cough	Meningococcal infections
1920				154.3		2.2	490	168	95.93		2.64
1921				201.5		5.8	275	189	94.70		2.23
1922				156.9		2.0	242	148	30.33	108	1.87
1923				131.4		3.1	680	159	27.61	154	1.93
1924				105.6		4.6	464	164	49.59	145	1.53
1925				82.1		5.3	194	162	34.16	131	1.69
1926				80.7	1.22	2.3	587	167	28.73	172	1.97
1927				89.8	1.01	8.8	388	180	31.59	152	2.63
1928			0.49	75.9	1.06	4.3	466	149	32.69	134	4.75
1929			.80	70.1	1.06	2.4	301	153	34.72	162	8.66
1930			1.18	54.1	.79	7.5	341	144	39.74	136	6.91
1931			1.27	57.1	.69	12.8	383	166	24.37	139	4.51
1932			1.22	48.0	.72	3.1	323	173	8.99	172	2.56
1933	1.79		1.42	40.2	2.82	4.0	319	174	5.17	143	2.35
1934	2.26		1.60	34.2	1.23	5.9	633	180	4.25	210	1.98
1935	1.43		1.58	30.8	.87	8.5	585	211	6.25	142	4.68
1936	1.40		1.64	23.4	.80	3.5	234	196	6.12	115	5.80
1937	1.73		2.08	22.2	.98	7.4	250	183	9.06	167	4.32
1938	1.82	13.2	3.37	23.5	1.01	1.3	634	153	11.51	175	2.23
1939	2.37	13.4	2.67	18.4	.73	5.6	308	132	7.55	140	1.53
1940	2.37	14.1	2.51	11.8	.80	7.4	221	126	2.12	139	1.27
1941	2.48	15.1	2.62	13.5	2.71	6.8	672	105	1.05	167	1.51
1942	2.10	20.0	2.41	12.1	.51	3.1	409	101	.65	143	2.85
1943	2.55	24.6	2.78	11.0	.59	9.3	472	112	.57	143	13.57
1944	2.51	30.1	3.34	10.6	.61	14.3	474	151	.30	83	12.28
1945	2.58	26.9	3.81	14.1	.59	10.3	110	140	.24	101	6.20
1946	2.92	17.7	4.20	11.7	.52	18.4	497	90	.24	78	4.06
1947	2.35	12.1	4.41	8.6	.55	7.6	155	65	.12	109	2.38
1948	3.33	16.6	3.42	6.5	.50	19.0	421	62	.04	51	2.31
1949	3.73	20.2	2.85	5.4	.61	28.3	421	59	.03	47	2.37
1950	3.02	15.8	2.32	3.8	.75	22.0	211	43	.03	80	2.50
1951	2.31	21.0	2.05	2.6	.73	18.5	346	55	.01	45	2.71
1952	2.75	14.9	1.63	1.9	1.23	37.2	439	73	.01	29	3.14
1953	2.81	10.4	1.28	1.5	1.22	22.5	284	84	.01	23	3.21
1954	2.19	8.6	1.13	1.3	1.62	23.9	424	92	.01	38	2.75
1955	2.04	8.5	.88	1.2	1.32	17.6	338	90		38	2.10

most complete control by immunization and improved therapeutics, it was formerly a very serious disease. Figure 66 shows, on a logarithmic vertical scale, the trend of diphtheria death rates in Massachusetts during the period 1842–1955; in Michigan, 1869–1955; and in New York State, from 1885–1955. Case reporting of diphtheria in these States began much later: 1893 in Massachusetts, 1884 in Michigan, and 1908 in New York State. Case fatalities based on reported cases in these States are more reliable than in many States that began reporting at later dates (*89*).

Important dates to remember in connection with diphtheria are the middle 1890's, when antitoxin was first used in the treatment of diphtheria, and 1913, when toxin-antitoxin was first used on children to prevent diphtheria. However, it was in 1920 and later that diphtheria immunization was used on a mass basis outside of institutions.

In Massachusetts, the death rate from diphtheria increased from about 15 per 100,000 total population in 1842 to roughly 200 in 1863 when an exceptionally high rate occurred, followed by a period of about 6 years with rates of roughly 50 per 100,000. At the end of this low period another epidemic occurred with rates again about 200 deaths per 100,000. The fall-off in the death rate after this latter epidemic

Table 8. Cases per 100,000 population for certain diseases required by law or regulation to be reported to health departments by attending physicians, 1920–55—Continued

[Adjusted for nonreporting where information is available]

Calendar year	Rocky Mountain spotted fever				Typhoid fever [1]	Paratyphoid fever [2]	Malaria		Endemic typhus	
	Total United States	Mountain and Pacific	Mountain	Pacific			Total United States	United States except Mountain [3]	Total United States	South [4]
1920		0.76	1.79	0.16	37.5		195.1	201.5	0.03	0.06
1921		.85	1.50	.48	46.0		197.0	203.4	.14	.10
1922		1.92	4.60	.43	33.0		161.1	166.3	.04	.07
1923		1.20	2.82	.34	31.0		137.1	141.4	.06	.13
1924		1.05	2.52	.29	31.0		106.0	109.2	.12	.30
1925		1.03	2.47	.31	40.0		95.0	97.9	.14	.40
1926		1.79	4.51	.46	35.5		106.5	109.7	.14	.42
1927		1.96	5.23	.39	29.2		127.2	131.1	.17	.55
1928		1.61	4.08	.46	22.6		148.8	153.2	.16	.49
1929		2.47	5.40	1.15	19.1		141.4	145.4	.20	.61
1930		1.65	3.39	.86	22.1		84.0	86.4	.42	1.29
1931	0.21	1.35	2.96	.63	21.4		59.5	61.2	.27	.82
1932	.35	2.67	6.97	.75	21.4		56.4	58.0	.77	2.42
1933	.38	2.72	7.01	.81	18.6		102.7	105.6	1.65	5.26
1934	.36	2.47	5.89	.96	17.6		108.3	111.3	1.09	3.40
1935	.39	2.74	7.60	.60	14.5		111.0		1.07	3.16
1936	.29	1.62	4.29	.46	12.4		107.4		1.35	4.24
1937	.34	1.83	4.70	.58	12.4		84.2		1.86	5.86
1938	.33	1.20	2.85	.50	11.5		64.9		1.77	5.54
1939	.43	1.45	3.61	.52	10.0		63.2		2.29	7.11
1940	.35	1.35	3.68	.36	7.4		59.2		1.42	4.34
1941	.39	1.85	5.90	.21	6.5		51.1		2.09	6.33
1942	.37	1.14	3.61	.20	4.2	0.38	44.9		2.79	8.47
1943	.35	.78	2.25	.23	3.5	.54	40.6		3.37	10.19
1944	.35	.40	1.43	.04	3.5	.54	43.4		4.06	12.37
1945	.36	.34	1.19	.06	3.2	.49	47.4		3.92	11.95
1946	.42	.35	1.01	.12	2.3	.52	34.7		2.40	7.36
1947	.42	.26	.94	.03	2.1	.66	10.5		1.43	4.38
1948	.37	.36	1.08	.11	1.9	.60	6.6		.80	2.48
1949	.38	.46	1.59	.06	1.9	.84	2.8		.66	2.07
1950	.31	.38	1.13	.11	1.6	.82	1.4		.45	1.42
1951	.23	.36	1.22	.06	1.4	1.16	3.6		.25	.73
1952	.21	.35	1.12	.09	1.5	1.67	4.5		.13	.40
1953	.20	.22	.70	.06	1.4	2.49	.8		.14	.42
1954	.18	.21	.77	.01	1.4	3.33	.4		.10	.31
1955	.18	.20	.62	.06	1.0	3.32	.3		.08	.24

[1] Typhoid fever includes paratyphoid fever from 1920 to 1941, inclusive; in 1942 paratyphoid fever amounted to only 0.38 cases per 100,000 population, so it was assumed that it was negligible prior to 1942 and omitted from the figures for typhoid fever from 1942 to the end of the record in 1955. Therefore this column represents predominantly typhoid fever alone.

[2] Years 1952–55 include salmonellosis along with other paratyphoid fever.

[3] Mountain geographic section, except New Mexico, is excluded.

[4] South includes: South Atlantic and East and West South Central geographic sections as used by U. S. Census Bureau.

of 1876 merges into the general decrease, which continued at a moderate rate until about 1927, when it fell precipitously (with only one reasonably small upturn) to a rate of about 0.03 per 100,000 population in 1954–55.

The reported case rate of diphtheria in Massachusetts declined very little from the late 1890's until a small break in about 1922; followed by a more precipitous break about 1924; prior to this break the death rate had been decreasing rather rapidly for many years. In Michigan, there was an upward trend in the reported case rates from about 1900 to 1928, when case and death rates both started precipitous declines. In New York State, both diphtheria death and case rates were declining sharply before the break of about 1927 began.

The case fatality of diphtheria showed a

Figure 68. Trends of the incidence of communicable and a few other diseases as reported by attending physicians and hospitals to local or State health departments and published by State or Federal health authorities, 1920–55 (*88*).

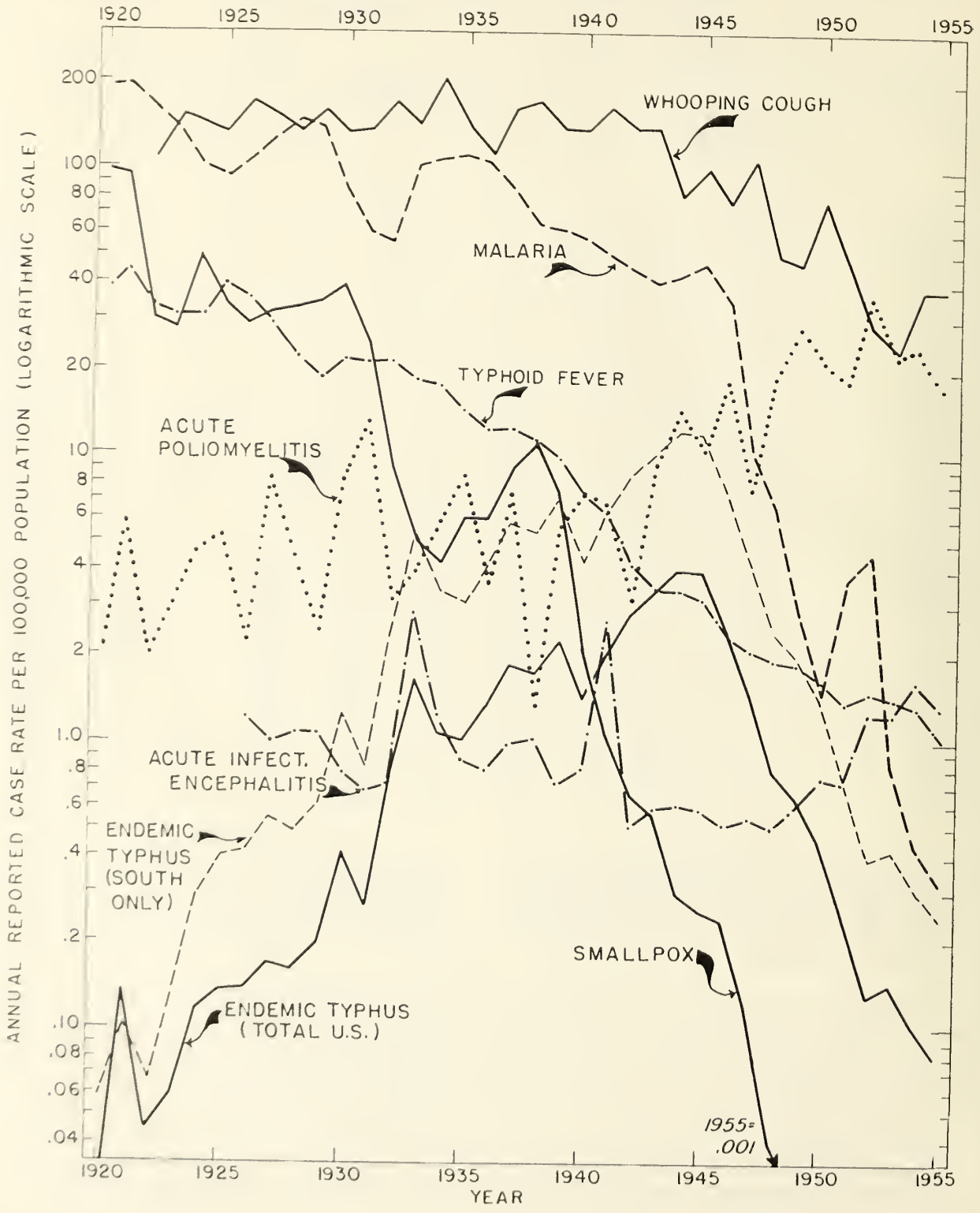
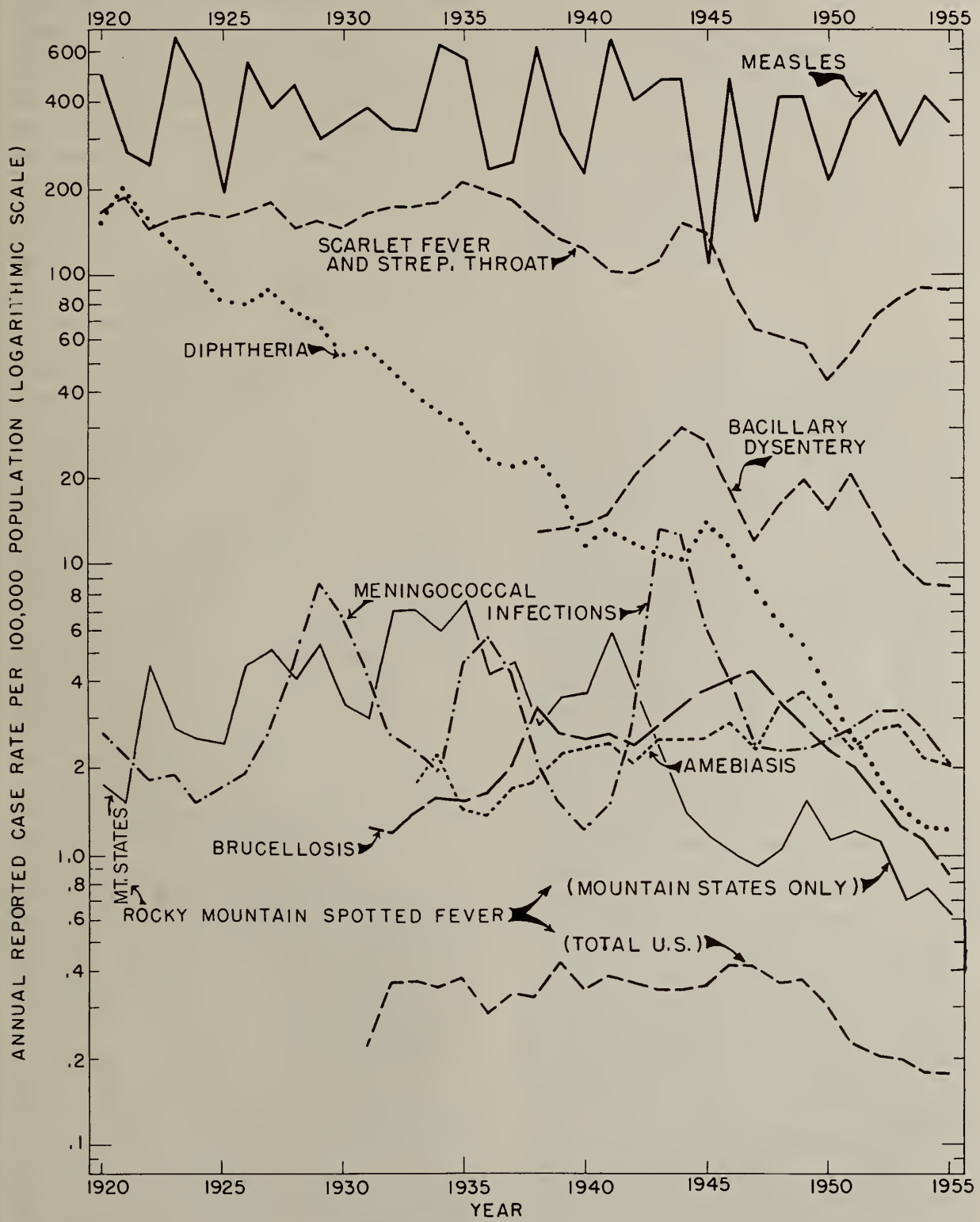


Figure 68. Trends of the incidence of communicable and a few other diseases as reported by attending physicians and hospitals to local or State health departments and published by State or Federal health authorities, 1920–55—Continued.



rather definite downward trend throughout most of the period covered by case reports, with a tendency to level off or to rise slightly after 1940 in Massachusetts and New York State; in Michigan the decline continues at about the same relative rate to the end of the record in 1955.

In the years since about 1946, the diphtheria and scarlet fever deaths and cases per year have been so few in these three States that most of the data have been combined into 2-year groups to prevent wide fluctuations from year to year that would be based on 1 to 4 deaths and on rather few cases.

Scarlet Fever

Scarlet fever death and case fatality rates have decreased a great deal but the general picture is different from that of diphtheria (fig. 67). Apparently, the scarlet fever death rate in Massachusetts increased from averages of about 50 to 100 deaths per 100,000 total population during the 20 years from 1840 to 1860 but declined thereafter at a rather constant percentage until about 1936, when a precipitous drop occurred from about 2 to 0.06 deaths per 100,000 total population in 1946–47 with a small rise thereafter to about 0.09 deaths in 1954–55. The case fatality rate followed a trend similar to that of the death rate from the beginning of the record in 1894, but the case rate increased gradually during this period until 1943, when it followed the death rate in a decline from 362 to 72 per 100,000 in 1952 (*89*).

The scarlet fever history in Michigan is generally similar to that in Massachusetts, particularly the curve for case fatality. The drop in the case rates in 1938 occurs a few years earlier than in Massachusetts, but in Michigan the drop in death rates begins a little later.

The New York State history of scarlet fever is also similar to that of Massachusetts, particularly in the death and case fatality rates. However, in New York State, the drop in case rates began earlier (about 1933) and reached lower rates than in either Massachusetts or Michigan.

The scarlet fever death rate declined in all three States by reason of fewer fatal cases, with little or no decline in total case rates except in the last 15 or 20 years. On the other hand, diphtheria declined rapidly during the last 25 or 30 years by reason of fewer total cases as well as fewer fatal cases. This difference would be expected because toxin-antitoxin and toxoid preventive immunizations have been widespread, as well as antitoxin for the treatment of cases; scarlet fever immunizations came later and have never been widespread, so better therapeutics or less virulent strains of the causative organism or both brought down the death rate earlier than the case rate.

Trend of Reported Cases of Notifiable Diseases Since 1920

Figure 68 shows trends of most of the acute communicable diseases from 1920, or from a later year in which they became generally reportable, to 1955. The arrangement is more or less arbitrary; the chart on which a particular curve is drawn is selected largely to avoid overlapping of the curves to the extent that it would be hard to follow a given curve without confusing it with some nearby overlapping curve. The States included for each disease are the total in the continental United States that required the reporting of the given disease, provided the Public Health Service received a report of cases from the State. When the numbers of reported cases of a given disease are generally few, say 5 or less per year, a blank is assumed to mean that no cases were reported to the State health department. On the other hand, if considerable numbers of cases of a given disease are being reported each year, a blank is assumed to mean that no report came in for that disease and the population of the State involved is taken out of the total for States which are presumed to have made reports on that disease for that year. If it is known that a given disease is not required to be reported in a State, its population is taken out of the population used for computing any rates for that disease (*88*).

Unlike the trends in earlier years in the three States previously discussed, the trend of reported cases of diphtheria is almost continuously downward at a moderate rate during the whole 35 years of record, from 154 and 202 cases per 100,000 total population in 1920 and 1921, respectively, to 1.2 in 1955. On the other

hand, the number of reported scarlet fever and streptococcal sore throat cases (fig. 68) in 1920 and 1921 indicated rates of about the same order of magnitude as diphtheria rates: 168 and 189 per 100,000 total population, with a decline to 43 in 1950, followed by a rise to 90 in 1955. Thus, the decline in the 35 years was far less than that of diphtheria in the total States, as was true in the three States with much longer records.

Smallpox is a disease with perhaps the longest record of effective immunization of any of the infectious diseases. In spite of some laxity in vaccinating in some areas, reported case rates of smallpox have declined more rapidly than those of any other disease included in figure 68: from an annual rate of 96 per 100,000 total population in 1920 to 0.001 in 1955. However, there were periods with no decline, such as 1922 to 1930, and a rise from 1934 to 1938, followed by a rather continuous and rapid decrease to 1955.

Typhoid fever has declined rather regularly from a rate of 38 per 100,000 in 1920 to 1.0 in 1955. From 1942 to 1955, data for typhoid and paratyphoid fevers have been reported separately; during this period, typhoid fever has continued to decline rather rapidly, from rates per 100,000 of 4.2 in 1942 to 1.0 in 1955, but paratyphoid (including salmonellosis) has increased from 0.38 in 1942 to 3.32 in 1955.

In 1920 reported cases of malaria amounted to 195 per 100,000 total population, declined to 95 in 1925, and in 1946, after two periods of several years each (1927–29 and 1933–37) with rates somewhat above those of the apparent trend, began a precipitous drop, which, with only one recession (1951–52), ended in 1955 with 0.32 cases per 100,000 population.

Many of these communicable diseases show peaks at more or less regular intervals. Poliomyelitis has increased from 2.0 cases per 100,000 total population in 1922 to 14 in 1944 to a maximum rate of 37 in 1952. Peaks have occurred at 2- to 4-year intervals during most of the period covered.

Meningococcal infections have not shown much long-time trend but have presented very large peaks at intervals of roughly 7 years, although the last interval was 3 years longer and the last peak was very much lower than any preceding one. The annual rates during the period here covered ranged from 1.27 in 1940 to 13.6 per 100,000 total population in 1943, the low and high points of the third peak.

Acute infectious encephalitis first appears in the tabulated reports in 1926 with 1.2 cases per 100,000 total population. After some decline, to a low of 0.69 in 1931, peaks of 2.8 in 1933 and 2.7 in 1941 appear, followed by a drop to 0.50 and a gradual rise to 1.6 and 1.3 in 1954 and 1955, respectively.

Measles peaks occur at 2- to 3-year intervals but with little or no long-time trend. Whooping cough has similar but much less marked peaks, with considerably less relative variation from low to high points. Although there is not much long-time trend in whooping cough prior to 1943, from that year to 1955 the rates drop from about 143 per 100,000 total population to 23 in 1953 but rise to 38 in both 1954 and 1955.

The rates for a number of diseases including rates for Rocky Mountain spotted fever and brucellosis, rise in the early years here plotted, then tend to level off somewhat. In recent years, rates for these diseases tend to decline, as though the disease were poorly reported in its early years, followed by years of moderately complete reporting and possibly then by moderate control of the disease. In recent years, rates of reported brucellosis have declined regularly and considerably from 4.4 per 100,000 population in 1947 to 0.88 in 1955, and Rocky Mountain spotted fever has declined from 0.42 in 1946 and 1947 to 0.18 in 1955.

Case rates for both amebiasis and bacillary dysentery have fluctuated considerably from year to year, except for a general decline in the bacillary form from 30 per 100,000 population in 1944 to 8.5 in 1955, with recessions in 1949 and 1951.

Rates for endemic typhus rose rather steadily and considerably from 0.03 per 100,000 population in 1920 to 4.1 in 1944, after which they steadily declined to the approximate starting level of 0.08 per 100,000 population.

Summary

This study is devoted largely to trends of illness, hospital care, and mortality over periods of 25 to 100 years.

Trend data are supplemented by age incidence and mortality from acute and chronic diseases as groups and from important specific diseases of each group.

Age variation is least in acute illness, considerably more in chronic diseases, and much more in mortality.

Most of the various types of illness rates are higher for women than for men, but mortality rates are consistently higher for men.

Consideration is given to the completeness of reports of illness obtained by house-to-house sickness surveys. The chief factors in obtaining complete reports seem to be the time between the household interview and the period for which illnesses are recorded, the seriousness of the illness, and whether each member of the household gives his own illness history or one person reports for the whole family.

Under 10 years of age, admissions to general and allied special short-term hospitals are higher for boys than for girls, but at the childbearing ages women go to hospitals considerably more frequently than men; however, if female genital and puerperal cases are eliminated, the differences between the sexes are much less.

Rates of first admissions to mental hospitals for the major psychoses, psychoneurosis, and mental disorders without psychosis are highest around 40 years of age and decline thereafter. The only exception is psychoses of the senium (senile psychosis and psychosis with cerebral arteriosclerosis) with the highest rates in the oldest ages. First admission rates for epileptics and mental defectives are highest from 10 to 19 years of age.

For women, the peak prevalence rate in long-term tuberculosis hospitals comes in the early 20's, but for men the peak rate is at 50 to 60 years of age. Federal hospitals carry a considerable load of male tuberculosis patients, presumably war veterans, with a few cases coming directly from active-duty status.

Patient loads in long-term hospitals for chronic diseases other than tuberculosis and mental conditions have the highest rates per 1,000 population in the ages above 55 years, and the lowest in the ages under 35 years.

Relative seasonal variation in the incidence of major disease groups and for many specific diseases are shown by incidence rates, by months, for acute diseases, and for acute exacerbations or episodes of chronic diseases for similar periods. The respiratory and the acute infectious diseases show the greatest seasonal variation, and the chronic diseases show the least variation.

Annual first admissions to non-Federal general and allied special hospitals in the United States increased from 56 per 1,000 population in 1935 to 117 in 1955; days of care per 1,000 population in these hospitals increased in the same period from 786 to 1,049; but hospital days per admission decreased from 14.1 to 8.9 days in that period.

The proportion of the total births in the United States that occur in hospitals has increased from 37 percent in 1935 to 94 in 1955.

During the period 1935 to 1955, annual admissions and days of hospital care per 1,000 population increased for mental hospitals but days of care per admission decreased considerably. The same three items for long-term tuberculosis hospitals showed some decreases but waves in the rates of about 6 years' duration are more prominent than long-time trends.

Age-specific annual tuberculosis death rates per 100,000 population for 3-year periods around the six censuses from 1900 to 1950 showed consistent decreases at every age group for each sex during the half-century. The larger decreases among males occurred between 20 and 70 years, and among females, between 30 and 70 years.

Women industrial workers show consistently higher illness rates than men, based on records of absences from work because of illness.

The trends of illness and mortality from nonbattle causes in the Army and the Navy, and mortality in the civilian population of com-

parable ages have all been generally downward since about 1865, aside from peaks that represent epidemics and disasters, such as nonbattle shipwreck. While no such long-time trends of illness are available for civilians, it seems probable that illness trends among civilian males of comparable ages would be similar to those of the armed services.

Mortality rates from diseases and accidents exclusive of battle casualties are about the same as rates for civilian males of comparable ages, but the general level of mortality from disease only is rather consistently higher among civilians of comparable ages than in the armed services.

Data published by the health department of New York City indicate that prior to about 1880, and especially prior to 1860, there were high peaks in death rates due to cholera and yellow fever, and as late as 1890 there was a small epidemic of typhus. Thus, in these early days civilians were also exposed to these pestilential diseases.

The trend of life expectancy in the United States and in three European countries is shown, and the increase in the percentage of persons who would be alive at specific ages according to the 1953 life table compared with the percentage who would be alive according to the life table based on mortality rates in 1900.

Trends of admissions to New York State mental hospitals are shown by diagnosis for total persons and for each sex for seven specific psychoses. Of the 7 psychoses, the admission rates for 2 are declining, but the other 5 increased rather sharply until about 1940, after which there is a tendency to level off. The trends of the rates are generally similar for men and women but several psychoses show large differences in the level of the two rates.

Mortality from chronic noninfectious diseases except of the heart has increased only gradually since 1900 but rates for the group of heart diseases has about doubled, from 1.4 to 3.2 per 1,000 population per year. By chance or otherwise, the increase in the rate of first admissions for all mental diseases to New York State civil hospitals has paralleled the percentage increase in mortality from heart diseases.

One section reviews mental and other illness in residents of urban and rural places. Another reviews the trends and epidemics of influenza in the United States from 1887 to 1956, and the last section shows trends in case rates per 100,000 population for specific notifiable diseases.

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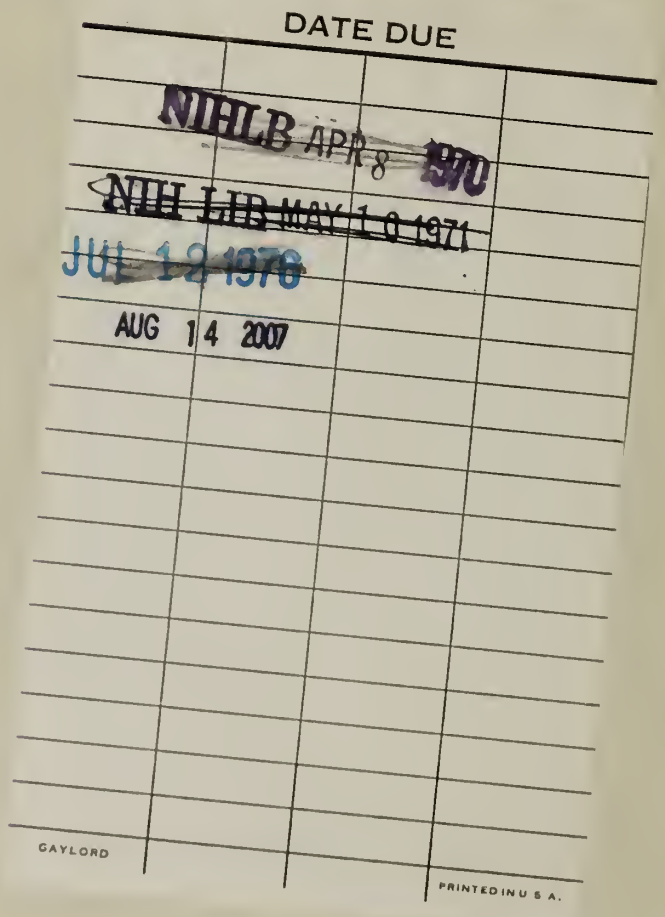

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